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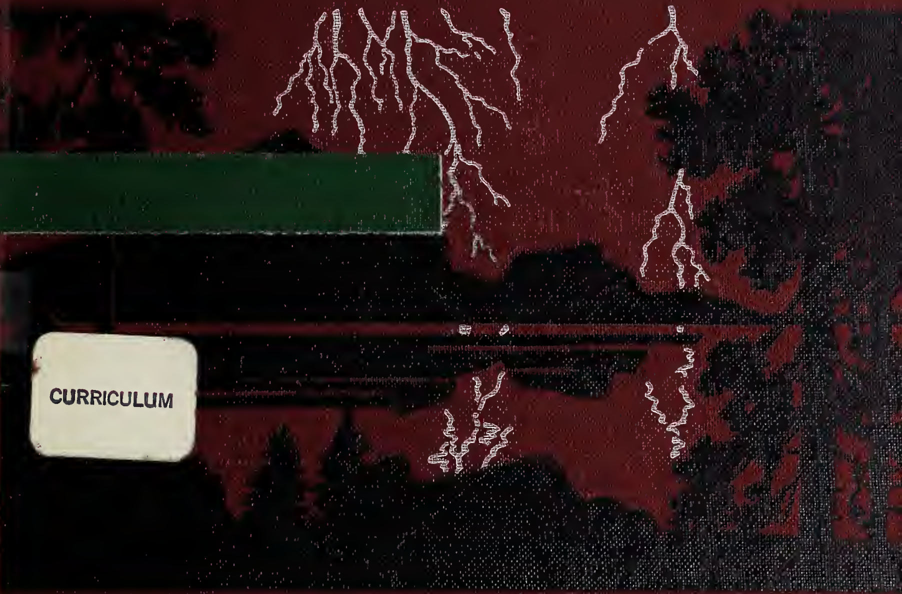

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OUR
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# Exploring in Science

*By* Gerald S. Craig
Professor of Natural Sciences
Teachers College, Columbia University

*and* Beatrice Davis Hurley
Teacher in Bronxville Elementary School
Bronxville, New York

Illustrated by
Heman Fay, Jr., Forrest Orr
Thomas W. Voter, *and* Jacob B. Abbott

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# OUR WORLD OF SCIENCE

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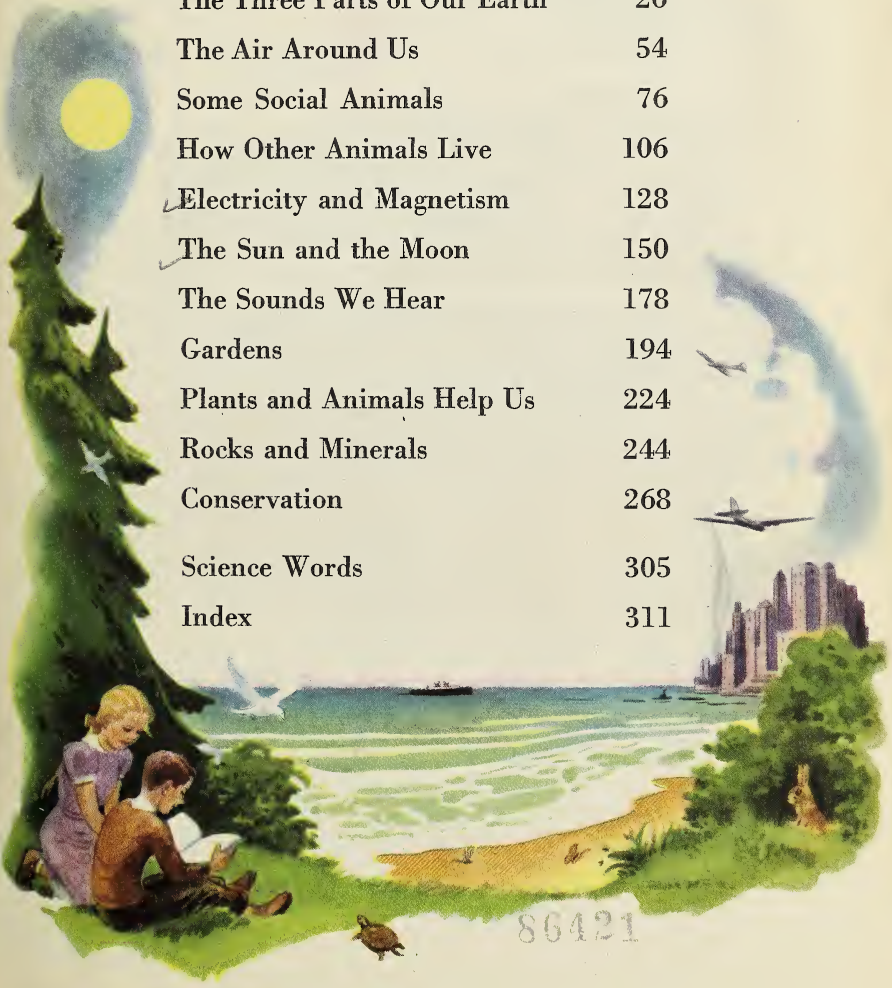

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# Our Big Round Earth

# The Earth Is a Planet

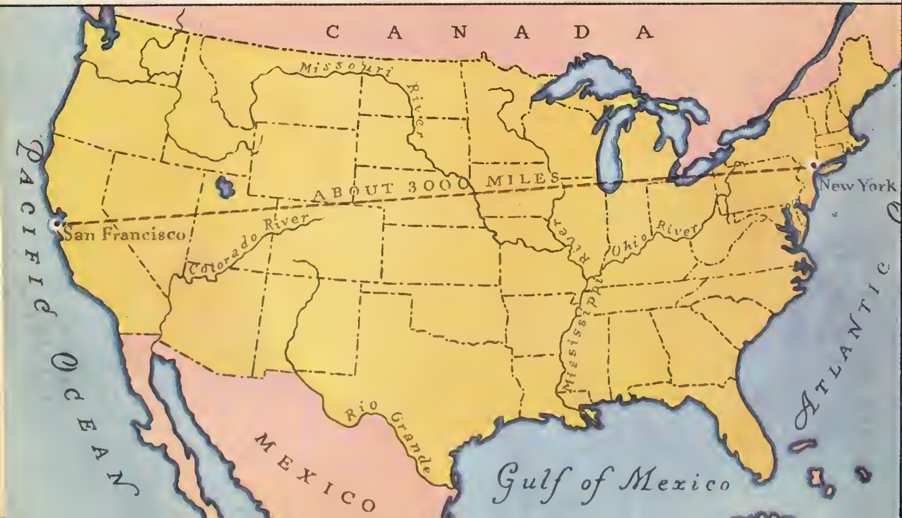
As you look into the daytime sky, you can see the sun. It is bright and round and yellow.

As you look into the nighttime sky, you can see thousands of shining stars. You can see the moon, too. And sometimes you can see one or two very bright objects. You call them stars, but they are really not stars. They are planets. They give a steady light. They do not twinkle, as the stars seem to do.

The sun has nine planets that travel around it. Our earth is one of these nine planets. It travels around the sun. All the eight other planets travel around the sun, too.

Our earth is round. The other planets are round, too. Our earth is small compared with some of the other planets. It is very, very small compared with the sun. It would take over a million earths to make a ball as large as our sun.

Yet to us our earth seems very large. Just how large is our earth? What is the longest trip you have ever taken? Have you traveled across our big country? Have you gone all the way across the country from the Atlantic Ocean to the Pacific Ocean? If you have, you traveled about three thousand miles. That was a long, long trip.



But the earth is much larger than that. If you traveled all around the earth at the equator, you would travel about twenty-five thousand miles. That is how large our big earth is. The trip around the earth would be about eight times as far as a trip across our own country.

So large and yet so small! Just when you think that the earth is about the biggest object ever, someone will tell you that our earth is very small. You already know it is very much smaller than the sun. It is only a tiny ball, compared with many of the stars in the universe.

"Universe" is the name we use when we talk about the whole world. It includes the earth, our sun and moon, the other planets, and all the other stars.

The Young Earth

# The Earth Is Old

How old are you? Are you nine years old? You may think you are getting old now that you are nine.

How old is your mother? I suppose you think she is quite old. She may even be thirty-five years old.

How old is your grandfather? Is he more than a half-century old? A half-century is fifty years. I suppose you think of your grandfather as really getting old.

Few people live to be a century old. That is one hundred years. Very few people live to have a hundred birthdays.

How many birthdays do you think our earth has had? You may be surprised when you learn that no one knows just how many birthdays our earth has had. But you won't be quite so surprised about it when you learn that our earth has had millions of birthdays.

Yes, the earth is millions of years old. It is older than any person living upon it. It is older than any animal living upon it. It is older than any tree living upon it. The earth is millions and millions of years old.

If you stop to think a bit, you know the earth must be very old. As you look out of your schoolroom window, can you see a hill or a valley and a river? Perhaps you live where you can see mountains. Or your home may be near great waterfalls or canyons.

What can you see from your schoolroom window that helps you to know the earth is very, very old? Remember that it takes many years for trees to grow big and tall.

It takes centuries to make mountains. River valleys are not made in a hurry. The waters of the Colorado River have taken centuries to make the Grand Canyon. The falls on the Niagara River have been wearing away rocks for many, many years.

Are there any large rocks near your school? They tell you that the earth is very old. In some places rocks were left by a great ice sheet that once covered the earth. The ice sheet came down over the northern part of our country, many, many centuries ago. It left many rocks.

# The Earth Spins Like a Top

Did you ever spin a top? It turns round and round on the smooth table. It spins very fast.

The big round earth is spinning, too. It goes round and round just as your top does.

The top is small. Our earth is large. The top spins around many times in a minute. The earth is so large that it spins around only once in twenty-four hours.

You have to keep on spinning your top. It stops every minute or so. Then you have to spin it all over again. The earth is not like that. Some great force started our earth spinning long, long ago. It has never stopped. It has kept right on spinning around all these millions of years.

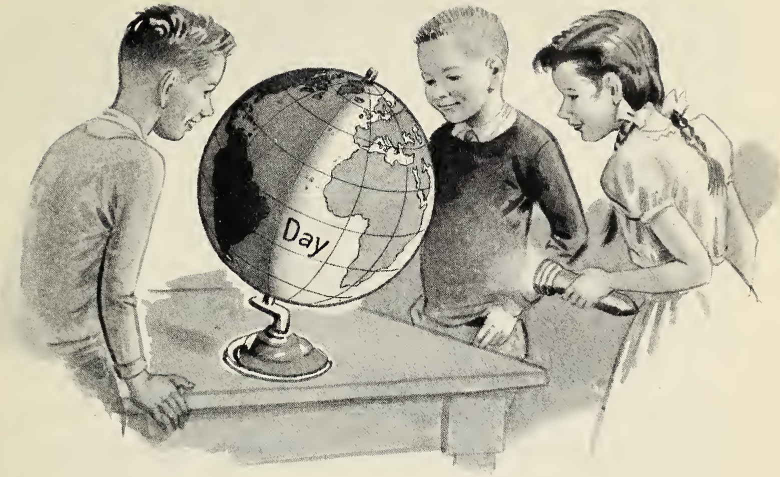
Scientists call this spinning of the earth, rotation. They say the earth spins, or rotates, once every twenty-four hours.

Look at your globe at school. Spin it around very fast. Spin it from west to east. That is the way the earth really rotates. It spins from west to east.

The rotation of the earth causes day and night. Now let us try to find out for ourselves why this is so. Place a globe, our earth, on a table. Have someone hold a lighted flashlight near the globe. The flashlight is the sun. If you can darken your classroom you will understand this experiment better.

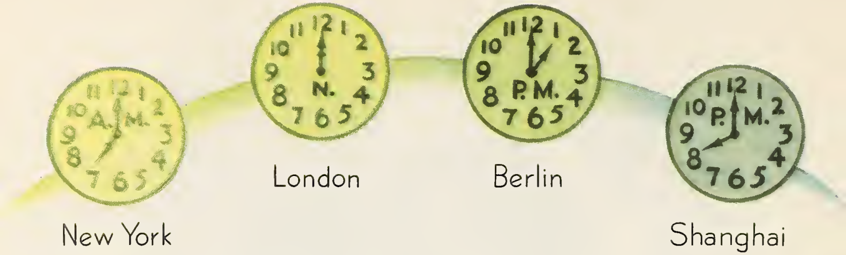
Look at the globe. How much of the earth is lighted? How much of the earth is dark?

Now find the place on the globe where you live. Then rotate the globe from west to east. Move it slowly. Keep your eye



on the spot where you live. What happens to this place on the globe? Does it have light part of the time? Does it have darkness part of the time?

Has this experiment helped you to understand why the place where you live has day part of the time and night the rest of the time? Since the earth is round, only half of it can be lighted at one time. For about twelve hours you have day. For about twelve hours you have night.



# What Time Is It?

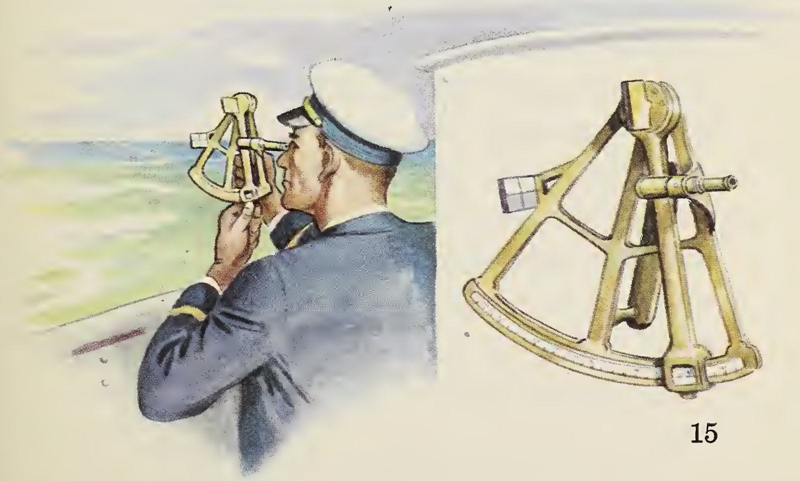
Clocks tell us about the spinning of the earth. The earth is a big master clock. It never loses time. It never gains time. It never stops running. It always gives us the correct time.

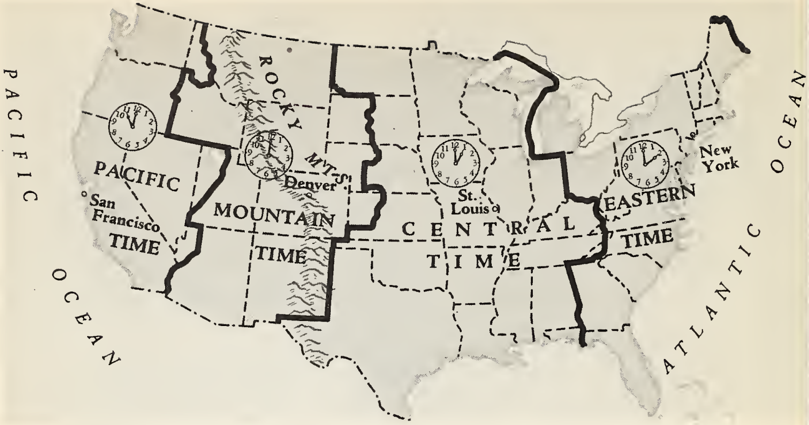
We use clocks to help us know what time it is. Our clocks are divided into twelve hours. The hour hand of the clock makes one trip around the clock every twelve hours.

You may wonder how we can be sure our clocks tell the right time. You know that sometimes our clocks do stop. We have to set them. How can we be sure we set our clocks right?

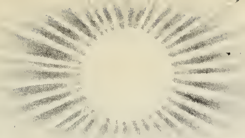
There are several master clocks that keep very accurate time. Every day scientists check these clocks to be sure that they are exactly right. These master clocks signal the time by radio. In this way radio stations, airports, ships at sea, and all of us can get the correct time.

When your clock stops, you can set it by the time announced over your radio. You may also be able to get the correct time by telephone. Many places have a telephone number which you can call when you wish to know the correct time.





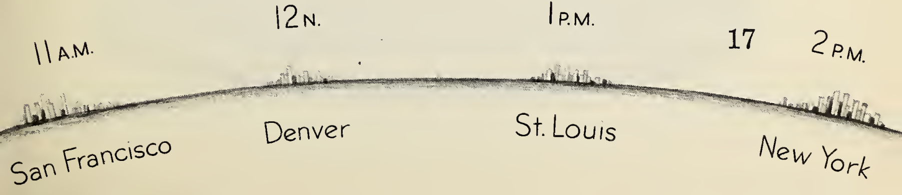
Not all places on the earth are having noon when our capital city is having noon. In fact only a part of the big earth has noon at the same time. The earth is divided into time zones, just as the clock is divided into hours. In the United States there are four time zones. Boys and girls who live near the Atlantic Ocean have Eastern Time. Boys and girls who live near Chicago have Central Time. Boys and girls who live farther west, where the mountains begin, have Mountain Time. Boys and girls who live near the Pacific Ocean have Pacific Time.



When the sun is highest in the sky above Denver, it is noon there. Then it is 11 A.M. in San Francisco. It is 1 P.M. in St. Louis. It is 2 P.M. in New York.

What time will it be in Denver when it is noon in San Francisco? What time will it be in New York when it is noon in St. Louis?

As the earth turns from west to east, the sun seems to us to be moving westward. It rises each morning in the eastern sky. It sets each evening in the western sky. We know that the sun is not moving westward. We know it is the earth that is rotating. We know that the earth turns from west to east. We know that it takes twenty-four hours for the earth to rotate once. That is why the sun rises in the east every morning and sets in the west every night.



# The Earth Takes a Long Trip

You know that the earth rotates once every twenty-four hours. Did you know that the earth is taking another trip at the very same time? Well, it is.

Did you ever ride on a merry-go-round? The pony you sat upon traveled around and around the music box.

Let's suppose the music box is the sun. Let your horse be the earth. The horse travels around the music-box sun.

Our earth really does travel around the sun. It has a road, or path, that it takes.

How long does one trip take? Well, the road is very long. The earth travels fast, but it takes it 365¼ days to travel once around the sun. Isn't that a long trip?

We measure our year by the length of time it takes the earth to travel once around the sun. We say the earth revolves around the sun. Once every 365¼ days the earth revolves around the sun. We call that a year.

If you are nine years old, the earth has made nine trips around the sun since you were born. How many trips has the earth made around the sun since your father was born?

# The Earth Pulls Things to It

Have you ever wondered about any of these things?

Why does an apple fall *down* toward the ground instead of *up* toward the sky?

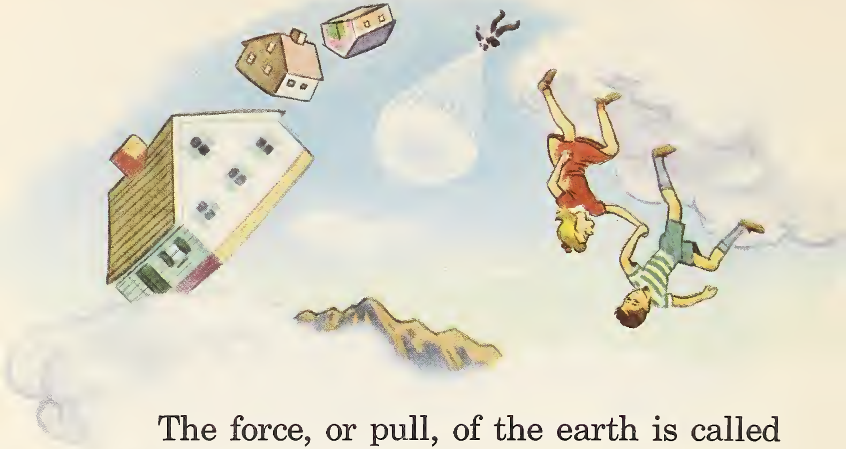
Why can't you jump high enough *up* into the air to get over your house?

Why does water run *down* the hill instead of *up* the hill?

Why does a ball come back *down* to the ground when you throw it into the air?

Scientists can give a reason why all these things happen just as they do. They know that the earth has great power to pull on things. It pulls on everything about it. It pulls on your body when you try to jump high up into the air. It pulls the apple down from the tree. It pulls water down, down, down. We say that it attracts other things.

When you throw your ball up into the air, the earth pulls it back to the ground. The earth pulls on boys and girls. It pulls on plants and houses. It keeps everything down on the earth.



The force, or pull, of the earth is called gravity. No scientist knows just what gravity is. All of us know what it does.

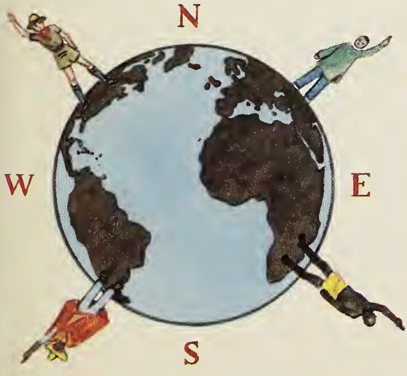
Stop to think about what would happen if gravity stopped working. Houses would go floating away into space. Waters would spill out of the oceans all over the mountains. When a pilot jumped from his airplane, his parachute might not float down to earth. You couldn't walk on the ground. You would be floating around up in the clouds somewhere.

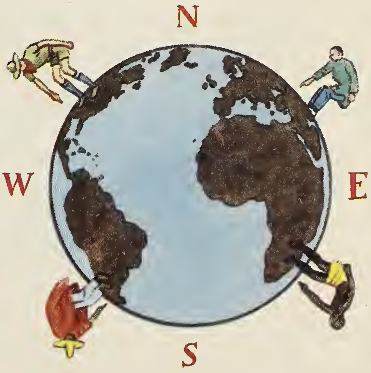
Of course none of these things could really happen. There could be no earth without gravity.

# What Is Up and What Is Down?

Do you know what " down " means? Do you know what " up " means?

Suppose you should ask John, a boy living in North America, to point up. Which way would he point? Suppose you should ask Lopez, a boy in South America, to point up. Which way would he point? Suppose you should ask Ming, a boy living in China, to point up. Which way would he point? Or suppose you should ask Bomba, a boy in South Africa, to point up. Would all these boys point the same way?





The picture on page 23 shows all the boys pointing in different ways. Up is away from the center of the earth.

Now suppose you should ask John, Lopez, Ming, and Bomba to point down. Which way would they point? Would they point the way the children in the picture on page 23 are pointing? Down is toward the center of the earth. It is the direction in which objects always fall.

We never speak of up and down except when we are speaking of the earth. The great universe of which our earth is a small part has no up and no down. There is no up and no down when we speak of the stars in the universe. There is no ceiling and no bottom to the universe.

If we could travel out into space, going from one great planet to another, we should never say we were going *down* to Mars or *up* to Jupiter. We use up and down only when we are speaking of things on the earth.

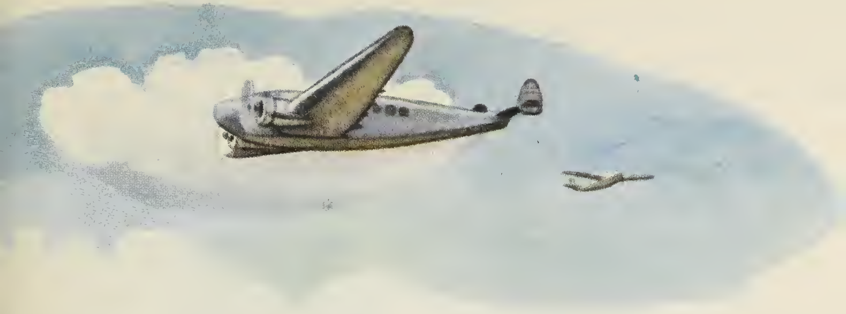
## Things to Think About

1. Bill lives in San Francisco. He goes to bed at 8 : 30 P.M. Jim lives in New York City. He goes to bed at 8 : 30 P.M., too. But still Jim and Bill do not go to bed at the same time. When the hands of Jim's clock say 8 : 30 P.M., Bill's clock says only 5 : 30 P.M. So Bill is just getting ready for supper when Jim is going to bed. How can this be?

2. There are many ways by which you can prove the force of gravity. List as many ways as you can think of to prove that gravity is at work. How many ways did you think of?

3. Have you ever noticed what a long shadow you have at 9 : 00 A.M. and what a short shadow you have at noon? Can you explain why your shadow is so short at noon when it was so long in the morning? Does it get longer again in the late afternoon?

# The Three Parts of Our Earth



# What Is the Earth Like?

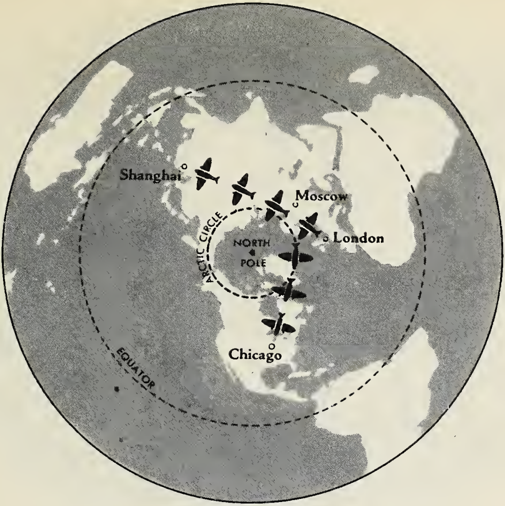
When you speak about the earth, what do you mean? Do you mean this planet, the earth? Do you mean the ground that your house is built upon? Do you mean the lands that you see on your globe? Just what do you mean when you talk about the earth?

Scientists tell us there are three parts to the earth. The land part of the earth is the solid part of the earth. The waters of the lakes, oceans, and rivers make up the liquid part of the earth. The air, or atmosphere, that is all around the land, is the gaseous part of the earth.

# The Solid Part of the Earth

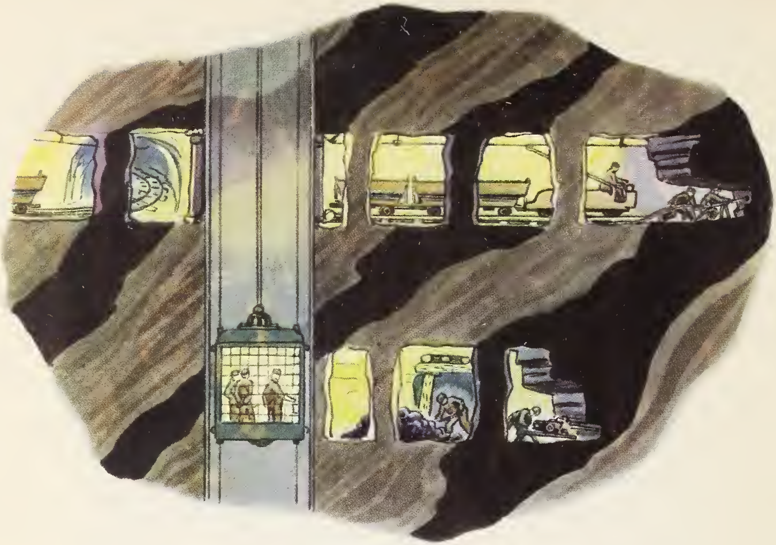
The land, or solid part of the earth, is our home. We build our houses upon the land. We work in the fields and raise the food we eat. We build churches and stores and schools upon the land part of the earth.

Long ago men were afraid to go very far from land. Great tales were told of the dangers of the sea. People thought that horrible monsters waited out there to gobble them up. If one went far enough, they said one would come to the edge of the earth and fall off.



We take many sea journeys now. Thousands of boats travel far and wide over the great water parts of our earth. Big ships carry tea and rubber, wool and silk from one country to another.

Now many people fly over the land in great airplanes. They go from Moscow to Chicago, and from London to Shanghai. But these mighty machines must return to the land part of the earth. They cannot stay in the sky forever. They bring their passengers and mail back to the land.



We live at the surface, or top part, of the land. Although man has lived upon the surface of the land for many years, he knows very little about what the inside of the earth is like.

Probably no one has ever dug deeper than ten miles down inside the earth. Our deepest mines are less than five miles deep. We get gold and silver, coal and iron from these mines under the surface of the land.

Oil wells have been drilled deeper than mines. Scientists study the rocks that are brought up from drilling the deep oil wells.

Scientists now know something about the inside of the earth. Still, much of the inside of the earth remains a mystery.

You may have been told strange things about the inside of the earth. People used to think the inside of the earth was a huge fire. They thought so because they saw fire and smoke shooting from some mountains. They sometimes saw hot water shoot out of the earth, too.

Scientists now tell us that the inside of the earth is firm, or rigid. They tell us the inside of the earth is heavy. The outside parts of the earth press against the inside of the earth. The inside parts press against each other. This causes great pressure down inside the earth.

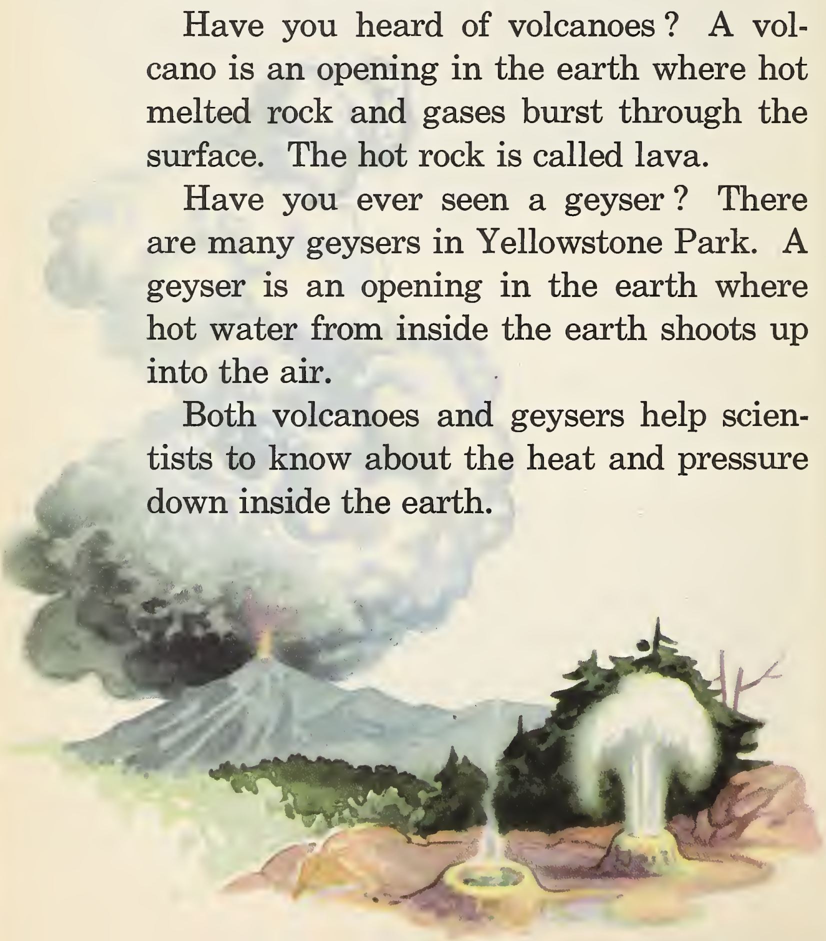
Remember that the earth is eight thousand miles thick. What a lot of pressure there must be on the middle of the earth!

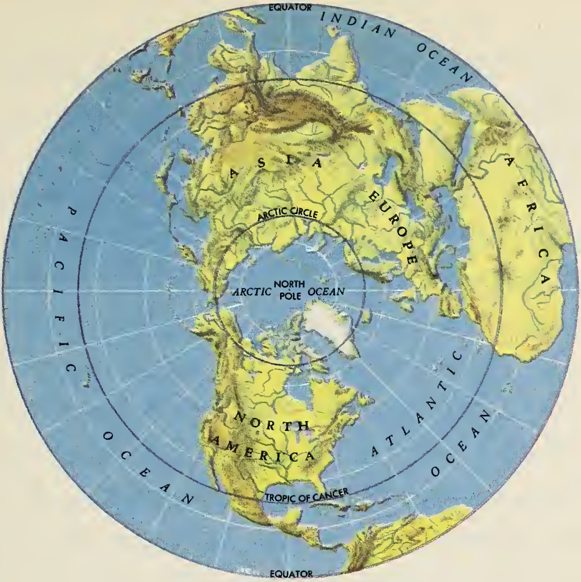
The inside of the earth is very hot. Sometimes it is hot enough to melt the minerals which are down inside the earth. These melted minerals often flow under the surface of the earth. They flow into cracks in the rocks down there.

Have you heard of volcanoes? A volcano is an opening in the earth where hot melted rock and gases burst through the surface. The hot rock is called lava.

Have you ever seen a geyser? There are many geysers in Yellowstone Park. A geyser is an opening in the earth where hot water from inside the earth shoots up into the air.

Both volcanoes and geysers help scientists to know about the heat and pressure down inside the earth.





# The Liquid Part of the Earth

Look carefully at your globe. Find the four great oceans. These oceans make up most of the water part of the earth.

About three fourths of the surface of the earth is water. Does that seem true to you as you look at the water parts on your globe?

You can really see only the surface of the water of oceans and lakes. They have filled in great valleys of the earth's surface. You would find that the bottom of the ocean is not level. It has great hills and deep valleys.

But even the oceans are not very deep. They do not reach far down toward the center of the earth. Men who have measured the oceans believe that the deepest parts are only about six miles deep. If you think about the whole distance through the earth, six miles is nothing at all.

These great bodies of water are very important, because they help to make many of the land parts of the earth more comfortable places to live upon. Water warms and cools more slowly than land. In summer many of the land parts of the earth would be very much hotter than they are if the winds from the water parts did not cool them.

In the winter some of the land parts of the earth would become very much colder than they do if the winds from the water did not warm them. It is very good that so much of the earth's surface is covered with water. It makes our earth a more comfortable place upon which to live.

Water not only helps us to be comfortable; indeed it keeps us alive. All living things, both plants and animals, need water in order to live. You could go without food for quite a few days, but you could not go without water for so long a time.

Some plants need more water than other plants. Some animals need more water than other animals. There is no plant and no animal which can live without water.

The water of oceans, lakes, and rivers is not the only water upon the earth. Down beneath the surface of the earth there is water, too. Some of this water comes up to the surface as springs. Some of it shoots out as geysers. In some places the water flows along in rivers under the ground, and does not come to the surface of the earth. Much of the water gets into tiny holes in the rocks. It moves quite slowly.

The atmosphere is all around the earth

# The Gaseous Part of the Earth

We live at the surface of the solid part of the earth. Above this solid part of the earth is the air, or atmosphere. This atmosphere is a part of the earth, too. It is the gaseous part of the earth. It forms a blanket which covers all the solid part and the liquid part of the earth.

The atmosphere is very important to us. Scientists say we could live three weeks without food, three days without water, but only three minutes without air.

Some children have asked how far the atmosphere goes. No one knows for sure. Some scientists think it may go out into space for five hundred miles. But the air away out that far is very, very thin. You could not live that far out in space.

You know that air gets thinner and thinner as you go away from the solid part of the earth. Pilots who fly in airplanes tell us that. Airplanes have flown about eleven miles up into the atmosphere. But the air up there is thin. The pilots have to wear oxygen helmets, so that they can get enough oxygen.

Do you know why the air is not so thin near the earth? Do you suppose gravity has anything to do with it?

Of course it has. Gravity pulls the air down to the solid earth. Gravity pulls air into all the cracks and holes around you. Gravity pulls air into the ground. Gravity pulls air into our houses and school buildings. The air is everywhere around you.

# The Layers of the Atmosphere

For many years no one knew much about the atmosphere. But since men have learned to travel high up into the sky they have learned a good deal more about the atmosphere.

The bottom layer of the atmosphere is the part we know most about. It is the part we live in. This part is called the troposphere. It goes up for six to ten miles. As one flies away from the solid part of the earth the air gets thinner and colder. Pilots wear oxygen helmets when they fly away up high in the air. They wear warm coats, too. The temperature is cold high up in the troposphere.

Have you ever gone skating when the thermometer read ten below zero? Do you remember how cold you got? Well, the pilots say that the atmosphere gets much colder than that. Sometimes their thermometers read forty or fifty below zero.

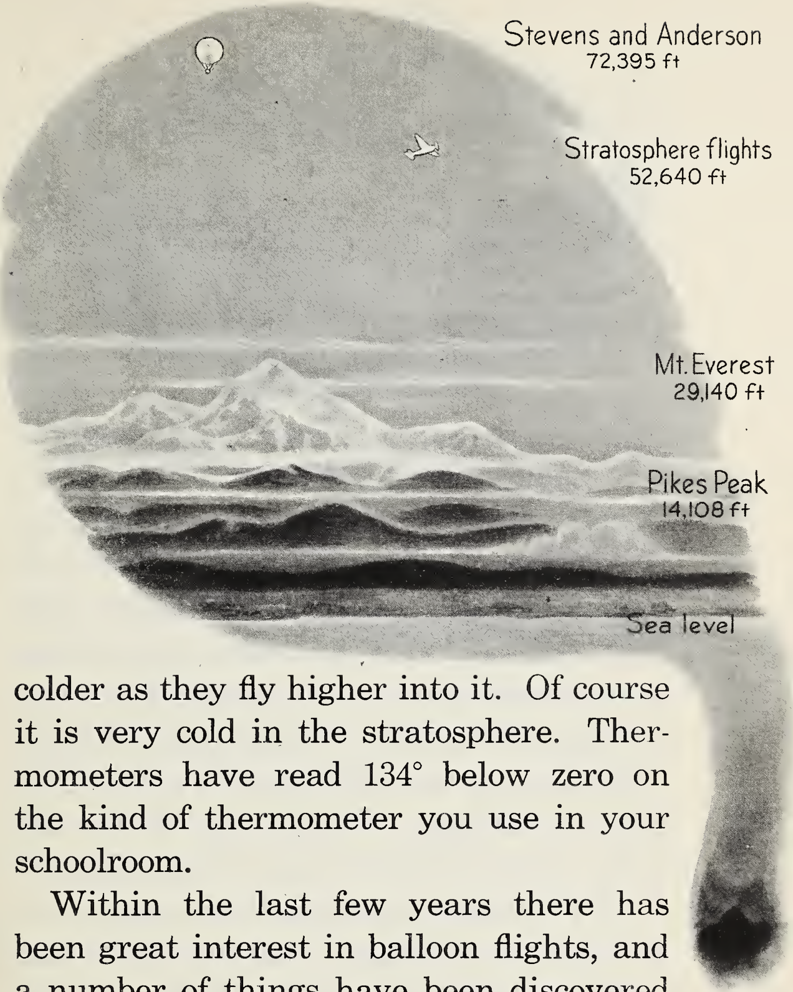
Above this bottom layer of the atmosphere is another part called the stratosphere. This layer of air is becoming very important to aviation.

Our first airplanes could not fly into the stratosphere. They flew in the troposphere, or bottom part of the atmosphere. But our new airplanes can and do fly in the stratosphere.

Isn't it cold up there? Yes, of course it is. The airplanes that fly so high are very well built. The pilots who fly in these planes wear oxygen helmets.

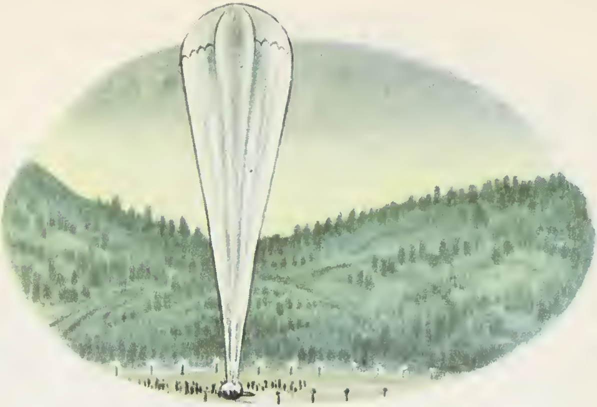
There are good reasons for wanting to fly in the stratosphere. Pilots of these stratosphere airplanes tell us that there is very little wind up there. The airplane flies along smoothly. There is not enough water vapor to form ice. So the pilots are not bothered by ice forming on the wings.

Pilots also tell us that the temperature stays about the same in the stratosphere. It does not keep on getting colder and



colder as they fly higher into it. Of course it is very cold in the stratosphere. Thermometers have read 134° below zero on the kind of thermometer you use in your schoolroom.

Within the last few years there has been great interest in balloon flights, and a number of things have been discovered about the stratosphere.



One such trip up into the stratosphere was made in South Dakota. Anderson and Stevens made it. They rode in the hollow metal ball, or gondola, of the largest balloon ever made. It was called *Explorer II.*

Stevens and Anderson shut themselves into the gondola. They wore very warm clothes. They also wore oxygen helmets.

As soon as the balloon was set free, it rose into the air. The big bag was partly filled with a kind of gas called helium. As the balloon rose higher and higher, it got larger and larger. The men threw out bags filled with lead to make the gondola lighter in weight.

At last the balloon bag was as big as it could be. It was now completely filled with gas. The heat of the sun on the bag had made the gas inside the balloon warm. The warm gas expanded and took up more room. The bag could get no larger. It had risen almost fourteen miles into the atmosphere.

You may wonder how the men got down. When the bag could get no larger, the balloon started to come back to the ground. Then the men let the gas out of the balloon. They let it out a little at a time. The balloon grew smaller and smaller. The gondola came closer to the ground. Finally, when it was almost touching the ground, they pulled a cord that tore open the bag. The rest of the helium gas rushed out and the gondola came to rest safely.

The instruments which were in the balloon recorded how cold the air was at different heights. They also recorded how thin the air became as the balloon rose.

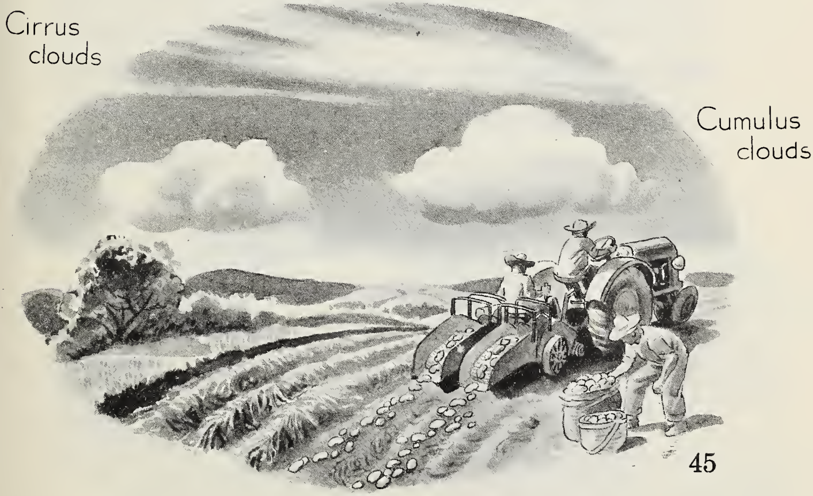
Other men have made balloon flights into the stratosphere. Scientists have learned more about the upper atmosphere from each of these trips.

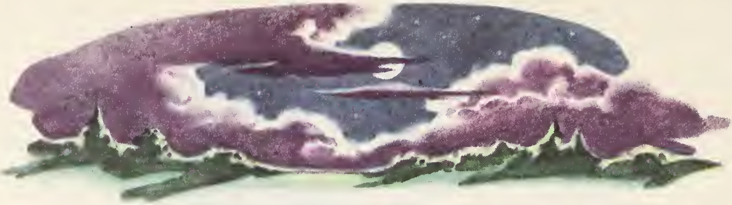
Now can you see why we say the atmosphere is a big blanket that covers the solid and liquid parts of the earth? It is over boys and girls in Canada, China, Egypt, and every other country. The atmosphere is everywhere around us. It goes up above our heads for several hundreds of miles.

You might think of an orange as the solid part of the earth. The peel of the orange could be the atmosphere. It covers the orange just as the atmosphere covers the earth.

# Clouds in the Atmosphere

The clouds you see in the sky are in the earth's atmosphere. They often seem to be far away. But the clouds you see are really very near the surface of the earth. They are not more than six or seven miles above the surface of the earth and are often within a mile or two above us. Sometimes clouds form right at the surface of the earth. We call these clouds fog.





Clouds are made of tiny droplets of water. These droplets of water were once just water vapor in the air. Water vapor is a gas. It cannot be seen. As the air cools, some of the water vapor turns to droplets of water. These droplets form clouds. Sometimes the water vapor freezes and clouds form from the tiny ice crystals.

The air is always getting either cooler or warmer. It does not keep the same temperature long. Clouds are always being made or changed. On some days there are many clouds to be seen. On other days there are few.

Clouds are not all alike. When the air is cool and the sun shines brightly, you see one kind of cloud. On dark, rainy days you see another kind. And on hot, bright days there are still other clouds in the sky.

You must have seen these different kinds. On a dark, rainy day there are low, heavy, dark clouds. They just spread out over the sky and shut out some of the sunlight.

Then there are the sheetlike clouds which are seen on gray, cloudy days. It is likely to rain or snow soon when the sky is full of such clouds.

On bright, sunny, summer days, about noon, the sky may be full of white clouds. They look like the white of an egg after Mother has beaten it, and often pile up in the shape of sheep's wool or round-topped castles. If these clouds turn black at the bottom, then watch out for a thunderstorm.

On clear days you will often see thin white clouds above you. They are quite high in the sky and trail off in long thin tails. These clouds often form at the end of a fair-weather time. Storms often follow such clouds.

Fliers watch the clouds. They may also listen to their radios to get weather news for flying. The gray clouds make it hard to land a plane, because they are so near to the ground. Pilots cannot land so safely when the clouds are low.

Clouds are so near the earth at times that you may be above them. If you are on top of a high building or a high hill, clouds will sometimes be between you and the ground. If you have driven through hilly country, you have often seen clouds in the valley below you.

# The Weather Changes

Now use your globe again. Find the equator. It is an imaginary line making a circle around the middle of the globe.

The places at or near the equator are the hot places on the earth. It is always summer weather in these places. People wear very few clothes. They build cool houses of wood and brush and branches.

The sun shines for nearly twelve hours each day upon the places near the equator. It shines straight down, too. The hot rays of the sun make these places very hot.

Now can you find the north pole and the south pole? These places are the very cold places on the earth. The Eskimo boys and girls who live near the north pole wear very warm clothes. These Eskimo children even wear two suits of fur to keep themselves warm.

The sun does not shine so long on the places near the poles. For six months of the year the sun never shines on the north pole or the south pole. The north pole and the south pole do not get as much sunshine as the parts of the earth near the equator. These are the very cold places of the earth.

Now look at your globe again. Can you find the places that are neither near the equator nor near the poles? These are the places on the earth that have warm summers and cool winters. Do you live in one of these places? In the summer the sun shines on these places for more than twelve hours and makes them warm. In the winter the sun shines on these places only part of the twelve hours.

Most of the people of the earth live in these cool and warm places. Most of the animals live here, too. Most of our crops are raised in these places. Which ones can you name? It is more comfortable to live in these places than in the very hot or cold places on the earth.

Summer

Winter

UNIVERSITY OF ALBERTA

## How Could You Prove These Things?

1. The earth has three parts.

2. Clouds are near the surface of the earth.

3. There must be a great pressure inside the earth.

4. The inside of the earth must be very hot.

5. Three quarters of the surface of the earth is covered with water.

6. There is water in the ground beneath the earth's surface.

7. The gaseous part of the earth is very important.

8. The liquid part of the earth is very important.

9. The solid part of the earth is very important.

10. The atmosphere gets thinner as one goes up into it.

## Things to Think About and Do

1. Flying long distances in fast airplanes has made the world seem much smaller. We are almost neighbors with the peoples of the most distant lands. We can visit them by flying sixty hours or less. What difference does this make in our need to understand other peoples of the world? How do you think that being neighborly with them might help us to find better ways to live and work together?

2. Try to find out more about the clouds. It is fun to watch clouds and learn to predict the weather from them. Here are some things to notice:

> What kinds of clouds are in the sky when it is raining?
>
> What kinds of clouds are in the sky on clear, cold days?
>
> What kinds of clouds are in the sky just before a thunderstorm on a hot summer day?

# The Air Around Us

# Air Is Real

Many children think that air is not real. They can't see it. They can't taste it. They can't smell it.

These children are wrong. Air is real, and you can prove that it is. Fill a large pan or an aquarium with water. Float a cork on the water. Now push a drinking glass down over the cork and into the water.

Push the glass to the bottom of the pan of water. Watch the cork. What happens to it? What pushes the cork down?

Now crumple a piece of paper into the bottom of the drinking glass. Crumple it so that it can't fall out of the glass. Be sure the glass is dry. Turn the glass upside down and push it straight down into the pan of water. Bring it back up. Feel the paper. Is it wet or dry? Why doesn't the water in the pan go up into the drinking glass and wet the paper? There must be something that keeps the water out. That something is air. The drinking glass was full of air when you put it into the water. No water could get in because the air kept it out.

# Air Has Weight

Almost everything that you know about weighs something. Even a feather has weight. So has air.

Does it surprise you to learn that air presses against everything with its weight? It presses against your face. It presses against your hands. It is pressing against your book right now.

You remember that air may go out into space for as far as five hundred miles. The weight of all this air presses down upon everything.

You may wonder why you can't feel it pressing against your hand or your face or your book. Air presses on all sides of your hand. It presses down on your hand. It pushes up on your hand. It presses your hand from the right and from the left. That is why you cannot notice that it is pressing at all. We say that the pressure is equal on all sides.

Air presses about fifteen pounds on each square inch of your hand and your face and your book. A square inch is as large as this :

If you have some scales, you can find out how heavy fifteen pounds is. Put one book on the scales and weigh it. Now add another book. Weigh the two books. Keep piling books on the scales. Stop when you have fifteen pounds of books on the scales. How many books did it take to weigh fifteen pounds ? This much weight presses on every square inch of your body.

All about you are ways to prove that air has pressure. Have you ever seen your mother open a tin can of fruit juice ? She always punches two holes in the can. Will the juice run out freely if she punches only one hole ? Ask your mother to let you try it. Punch only one hole first. Does the juice run out easily ? Now punch a second hole. What happens now ?

The juice runs out of one hole because air outside the can presses against the juice through the other hole in the can.

You can try another experiment with an empty tin can. This experiment proves in a different way that air has pressure. Punch a nail hole in the side of the can near the bottom. Put water in the can. The water runs out because air is pushing down on it from above.

Now press a piece of paper over the top of the can. What happens? Does the paper keep the air above the can from pressing on the water? Take the paper away. Does the water start running out of the hole again?

Have you ever drunk milk through a straw? Why does the milk come up through the straw? When you suck on the straw, you pull the air out of the straw. Then the milk is pushed up into the straw. It is pushed up into the straw by the air that presses down on the top of the milk in the bottle.

What do you think would happen if you used two straws in the milk? Could you drink faster that way?

Here is another experiment that proves that air presses against things. Hard boil an egg. Cool it and take off the shell. Place it at the top of a quart milk bottle. Does it drop into the bottle?

Next crumple some paper. Put it down into the milk bottle. Set it afire and burn it. Some of the air is used as the paper burns. There is not as much air inside the bottle now.

Place the egg over the top of the bottle again. Watch and see what happens now.

Why did the egg drop into the milk bottle? Where was the air that did the pushing on the egg?

Now try to get the egg back out. Turn the milk bottle upside down. Will the egg fall out?

You can make it come out in this way. First fill the bottle to the top with water. Then empty the water. The burned paper will float out with the water. Turn the bottle upside down. Now hold your mouth over the top of the bottle. Blow hard into the bottle. You push air into the bottle as you blow. There is much more air inside the bottle now than there was before. Soon the egg will pop out of the bottle.

The air inside pressed against the egg. It pressed harder on the egg than the air outside the bottle. Out came the egg.

# Air Can Expand

Air can expand, or spread out. You can watch air spread out. Use an old balloon for this experiment. Blow just a little bit of air into it and tie a string around it. The old balloon will not be smooth like a new balloon. It will be wrinkled.

Now hold the balloon near a warm radiator or stove. Watch the wrinkles fill out with air. Why does the balloon get bigger?

The air inside the balloon becomes warmer. As it gets warmer, it spreads out, or expands. Some of it spreads out into the wrinkled places in the balloon.

Now cool the air in the balloon and watch to see what happens. Does the balloon get smaller? Does it get all wrinkled again?

You can do another experiment to show that air expands when warmed. Tie a balloon over the neck of a Pyrex nursing bottle. Set the bottle near a warm radiator. Watch the balloon.

# Air Is a Mixture

Air is not just one gas. It is a mixture of gases. About one fifth of the air is oxygen. This is the only part of the air we use in our bodies. We breathe in all the gases of the air. But we use only the oxygen part of the air in our bodies. The rest of the gases we just breathe right out again.

Fire uses the oxygen in the air when it burns. You can watch a burning candle use up oxygen. Light a short candle. Put it in a low candleholder. Now place a large drinking glass over it. The candle burns lower and lower and finally goes out. It does not go out until much of the oxygen in the glass has been used.

Besides oxygen, air contains nitrogen and very small amounts of several other gases. Suppose you imagine that an apple is the air. Cut about one fifth of it away. This part represents the oxygen part of the air. Now shave off the very thinnest piece you can. The piece should be about as thin as a piece of paper. This very thin slice of apple represents several other gases that are in the air.

All the rest of the apple represents the nitrogen in the air. Isn't there a lot of nitrogen? We do not use this nitrogen when we breathe the air into our bodies. We use only the oxygen. We breathe the nitrogen right out again. We also breathe out the other gases along with the nitrogen.

A tiny bit of the very thin slice of apple represents the helium gas in the air. Helium is the gas we use in dirigibles. There is also a very little bit of neon gas in the air. Neon is the gas in the neon lights in store windows. There is some water vapor in the air. Water vapor is a gas, too.

Another part of this very thin slice of the apple is the carbon dioxide gas that is in the air. Carbon dioxide is a heavy gas. You can make some by pouring two tablespoons of vinegar on two tablespoons of baking soda in a glass jar.

Fire cannot burn in carbon dioxide gas. Try putting out a candle flame by tipping the jar of carbon dioxide down toward the candle. The gas is heavy. It will flow out of the jar and put out the candle.

Have you a fire extinguisher at school? Many fire extinguishers use carbon dioxide to put out fires. When you tip the fire extinguisher upside down, the materials inside mix and form carbon dioxide gas.

Carbon dioxide is used inside rubber boats or rafts like the one you see in the picture. It blows up the boat just as air blows up a tire.

Carbon dioxide is usually a gas. But it can be changed to a liquid or even a solid. All of you have seen dry ice. Ice cream is packed in it when it must be kept very cold for a long time.

Dry ice is solid carbon dioxide. It is very, very cold. Sometimes the ice cream which has been packed in dry ice is frozen so hard that you have to let it thaw out before you can even cut into it.

# We Use Air

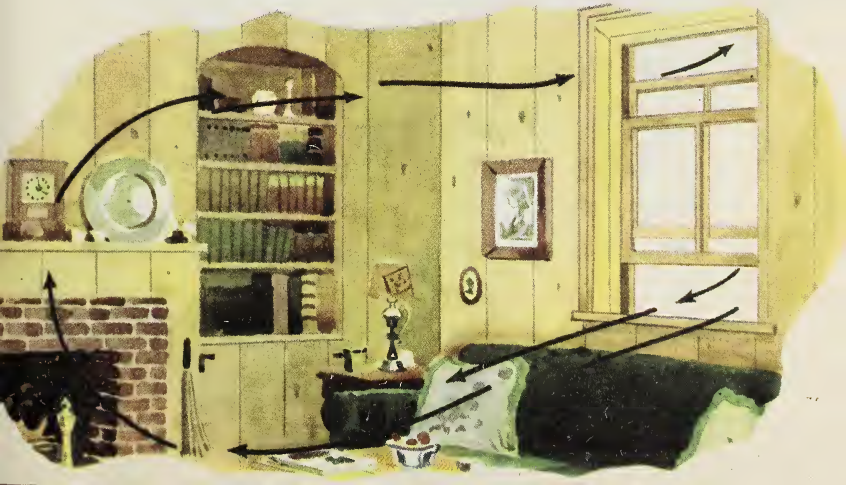
You know how important air is. You breathe air. You could live only a few minutes without it.

All animals need air. Even the fish that live in the water breathe air. They breathe air that is mixed in the water. Frogs and turtles come to the top of the water to breathe air. Have you ever seen them stick their heads up above the water? They are breathing air when they do this.

We make use of moving air in our homes. The moving air helps to keep us comfortable. Some homes have fans in the heating system. These fans keep air moving in all the rooms of the house.

When we go to bed at night, we open our windows. Many people open their windows a little at the top and a little at the bottom. The lighter warm air is pushed out of the open window at the top.

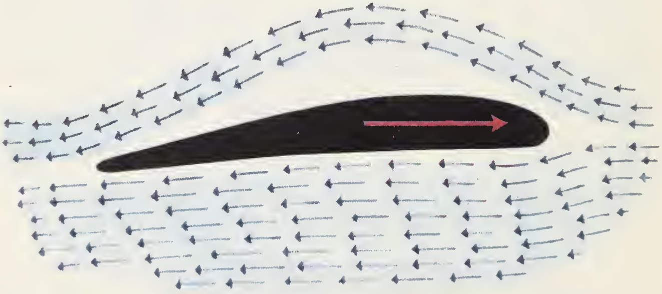
People used to think that the amount of oxygen in the air was very, very important. No one wanted to stay long in a closed room. They were afraid that there would soon be too little oxygen and too much carbon dioxide in the room. Today scientists tell us that we do not need to fear the carbon dioxide in the air. We must have oxygen, but we have learned that the moisture, the temperature, and the movement of air are also important.



# Air Pressure Helps Us

Even in olden days men made use of air pressure. They made sailboats that the moving air, called wind, pushed across the seas. They built large windmills and let the wind pump the water for them.

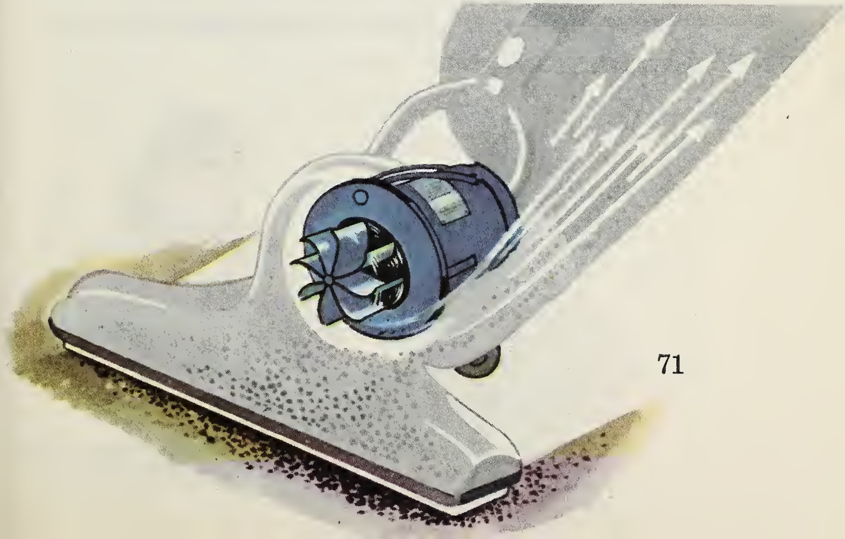
Today we use the pressure of air to help us fly our airplanes and gliders. We build airplane wings of this shape:



When an airplane is flying, the air pressure on the top of the wing is not as great as the air pressure under the wing. So the pressure of the air under the wing helps to push the airplane up.

Parachutes use air pressure, too. When a pilot jumps from his plane he pulls a cord to open the parachute. The air pressure on the under surface of the open parachute is greater than it is on the top surface because of the speed of falling. So the flier floats gently down to the ground.

Your mother makes use of air pressure in the vacuum cleaner. The motor in the cleaner pulls most of the air out of the inside of the cleaner. The pressure of the air on the outside of the cleaner is strong. Air rushes into the dust bag so fast that it takes dirt, bits of paper, and other things with it.



Have you a fountain pen? When you fill the pen, you make use of air pressure. A rubber tube inside the pen holds the ink. When you press the lever on the pen, you force air out of the rubber tube. Now when you put the pen into the ink bottle and take your hand away from the lever, the air pressing on the ink in the bottle forces ink into the rubber tube.

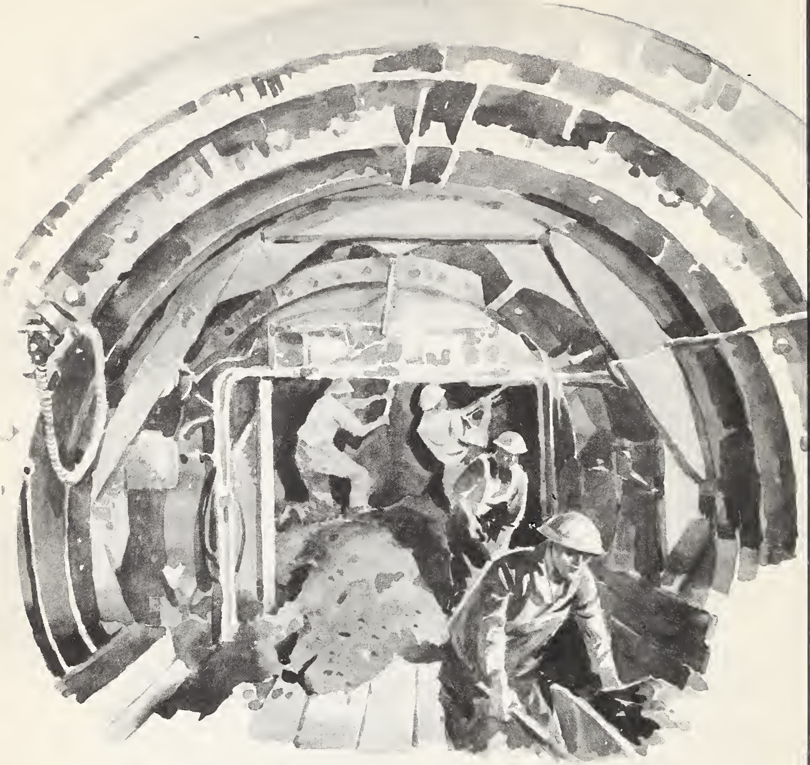
Try some experiments with a medicine dropper. See if you can explain what happens when you press on the rubber bulb. Can you make water come up into the dropper? Why does water come up into the dropper? Does air pressure help you to explain how a medicine dropper works?

Did you ever blow your breath into a paper bag? The bag got big and hard. Then when you hit the bag with your hand, it broke and made a big bang.

What you did was to blow a lot of air into the bag. You pressed a lot of air close together inside the bag. You really made compressed air. When the bag broke, the air rushed out so fast it made a loud noise.

We use compressed air in many ways. We pump air into the tires of our car. We say we compress the air into our automobile tires. That means that we push lots of air into a small space.

Compressed air presses even more than air that is not compressed. It makes the tires hard enough to hold up the weight of the car. Your bicycle tires are hard when they are filled with compressed air.



Men who dig tunnels under rivers make use of compressed air. They work in huge tubes of compressed air. The compressed air is so strong it keeps the water from coming into the tubes where the men are digging.

Have you ever noticed this sign on the back of big trucks?

DANGER
AIR BRAKES

These brakes work with compressed air. They stop the car very quickly.

### Some Questions to Answer

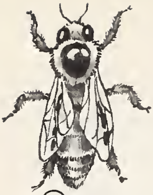
1. How can you be sure that air is a real thing?
2. How does man use the different gases in the air?
3. Why does a candle flame go out when you cover the candle with a drinking glass?
4. Why will sand put out a camp fire?
5. How does air help man do his work?

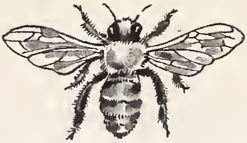
# Some Social Animals

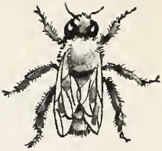
# Honeybees Are Social

Have you ever watched honeybees gathering the sweet sap, or nectar, from flowers? They buzz and buzz as they fly from one flower to the next. When they have enough nectar, they fly back to their hives.

Many thousands of honeybees live together in one hive. What a busy place a beehive is! Let's see what goes on inside the hive. Let's see how such a large family can live together in one house.


Queen


Worker


Drone

There are three kinds of honeybees in each hive. There is one queen bee. She is a long bee. She has a long slender body. Then there are some drone bees. They are fat fellows. There are thousands of smaller bees. These are the workers.

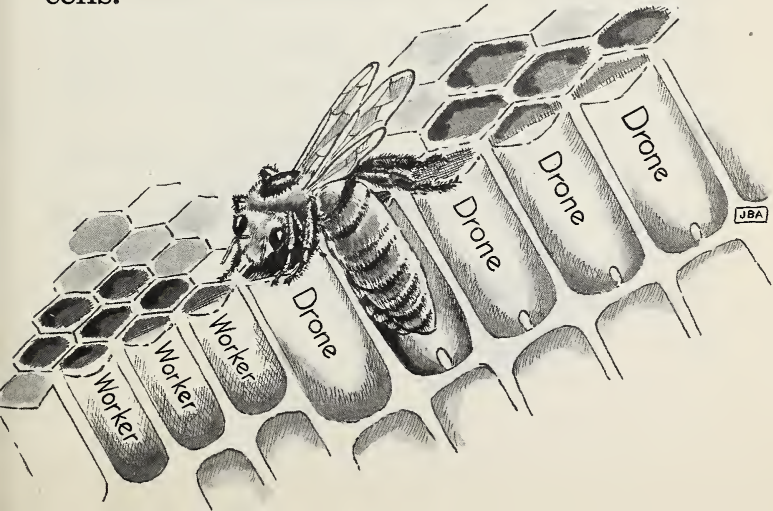
## The Queen Bee

The queen bee is the mother bee. She lays thousands of eggs during the summer. She is fed very special food called "royal jelly." A guard of worker bees keeps her from harm. They form a circle around her.

Just think how very important the queen bee is. She lays all the eggs that hatch into bees. Nothing must happen to the queen bee. The bees will not work without their queen.

The queen bee mates once during her life. She leaves the hive and flies high into the air. Many drone bees follow her. The drones are the father bees. One drone mates with the queen. Then she returns to her hive.

Soon after she mates the queen begins to lay eggs. She lays one egg in each cell. The cells are little six-sided rooms made of wax. There are thousands of wax cells in the hive. The queen lays many eggs that will hatch into worker bees. She places these eggs in the smallest cells. She lays some eggs that will hatch into drones. These eggs are put into the larger wax cells.



# The Drone Bees

The drones are the father bees. They are called male bees. There are a few drones in each beehive. You can tell them because they are fatter and larger than the workers.

The drones are helpless bees. They cannot do any of the things the worker bees do. They cannot gather food or guard the queen. They cannot sting, because they have no stinger.

You may wonder what they are good for. One of them will mate with the queen bee. If this mating did not happen, there would be no baby workers. The beehive would soon be empty.

In the fall the drones die. They are not wanted in the beehive. The workers stop feeding them. Since the drones cannot feed themselves, they starve to death.

# The Worker Bees

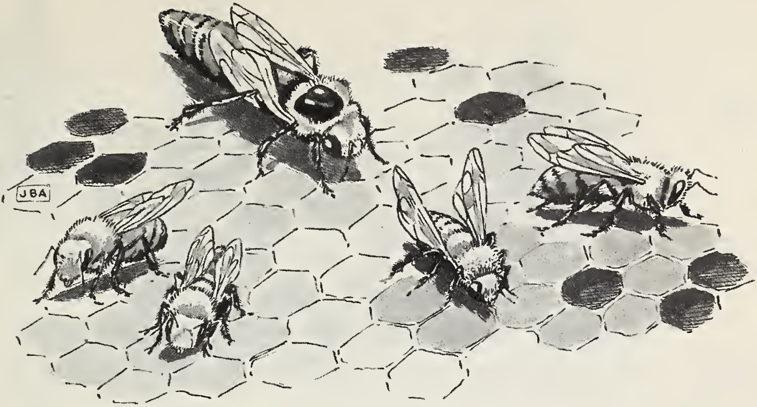
Worker bees do most of the work of the hive. They have many jobs. Some do one thing, and some do another. They work very hard and die young. Most worker bees live only about six weeks. A queen bee lives from four to five years.

The first eggs the queen lays in the spring hatch into worker bees. These worker bees have much work to do. They must not expect help from the queen. She is busy laying eggs. Many, many more bees are needed as the summer goes along. The queen must lay thousands of eggs.

The worker bees must mend the hive. They gather a sticky material from the buds of trees. It acts as glue does when you use it. All the holes and cracks in the hive are filled with it.

Then the workers start making wax. They need wax to make the cells, or rooms, for the hive. The queen lays eggs in some of these wax cells. The workers store food in other cells. The honey is stored in still other cells. Many cells are needed.

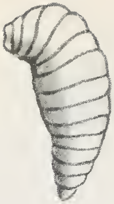
In early summer the workers eat and eat. They eat nectar. Then they crawl to the top of the hive and hang themselves up. How funny they look! All their heads are hanging down.



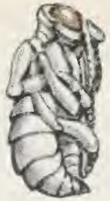
Soon wax scales begin to appear on the under side of their bodies. Other workers scrape off the wax and start making the many cells that will soon be needed in the hive. They begin to build the cells at the top. They make row after row of wax cells.

Some workers act as guards for the hive. They stand guard for the queen. Others stay near the door of the hive to watch for enemies. Sometimes a mouse enters the hive. The guard bees sting it to death. Bees from other hives are not welcome. The guards kill them or chase them out.

Egg



Larva



Pupa

Adult bee

Some worker bees are nurses. They care for the young of the hive. The eggs hatch into wormlike creatures called larvae. The nurse bees first feed the larvae with a milky white liquid from their own mouths. Later they feed them beebread. They make this beebread from the yellow pollen dust of flowers.

After six days the larvae are ready to change their form. The nurse bees make a door for each wax cell. The larvae then change into pupae. They are changing from larvae to full-grown bees. After twelve more days they eat off the door of the cell and crawl out. At first they are all white, but in a day or two they are full-grown bees.

The larvae that will become queen bees get very good care. The nurses feed these larvae a very special beebread called royal jelly. These bees grow larger than the workers. As they grow, their wax cells have to be made larger for them.

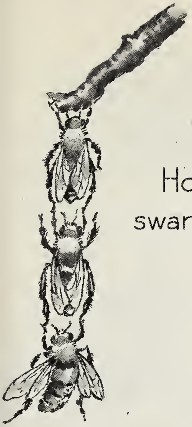
Some other worker bees gather nectar from the flowers. The workers fly from flower to flower. They stick their long tongues deep into the nectar cup of each flower. How sweet the nectar tastes! They fill their honey sacs, or honey stomachs, with this sweet nectar.

Back to the hive flies the worker bee with a sac full of nectar. On the way the nectar mixes with a juice from the worker's stomach. Each drop of nectar is stored in wax cells made just for this use. One worker makes many trips a day. Back and forth, back and forth, back and forth it flies. Each drop of nectar helps to fill up the wax cells. When the cells are filled, the worker seals them.

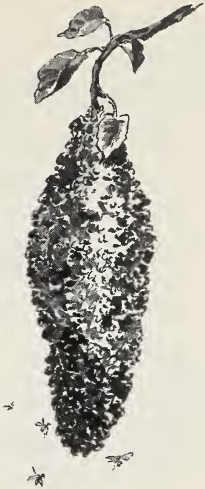
The nectar now needs to be turned into honey. Worker bees fan their wings all night. The fanning evaporates some of the water in the nectar. What is left is a thick sweet liquid called honey. And you know how good that is on bread or pancakes. Don't you?

Worker bees gather pollen from flowers, too. It sticks to the long hairs on the worker bee's body. The long hairs on the hind legs of the bee form little baskets. The worker bees push pollen into these baskets. They use their hind legs to push the pollen into the baskets.

The load of pollen is heavy for the worker bee. Other workers take the pollen out of the baskets. They put it into wax cells. This pollen is mixed with nectar and made into the beebread which is fed to the baby bees.



How a swarm starts



A swarm of bees

# Why Bees Swarm

You may have heard that bees sometimes swarm. Do you know why they swarm? You remember that the queen bee lays many, many eggs. Most of these hatch into worker bees. As the young bees hatch, the hive becomes very crowded. Many of the old bees leave the hive. The old queen usually leaves with them. They fly in a buzzing swarm to a fence or tree that is near.

Bee-keepers try to watch their swarms. They do not want to lose their bees. When the bees swarm, the bee-keeper brings a new hive. He gently shakes the bees into a basket and places them in the new hive. He keeps the door of the hive closed for a day or two.

For a while there may be no queen in the old hive. A young queen soon hatches. She looks for other hatching queens. You remember there can be only one queen in a hive. So the strongest queen kills the other queens by stinging them to death. Sometimes there is a real battle before one queen wins. She is then the new queen of the hive.

Such is life inside a beehive. Every bee does its work well. No wonder such a large number of bees can live together in one hive.

They are not like your family. They do not talk to one another about their work. They do not play together. They do not make plans as your family does.

Each member of the bee family has his own jobs to do. He does these jobs and no others. He lives with the other bees in the hive, but he does not have a family life quite like yours and mine.

# Bumblebees

What a busy, merry fellow the bumblebee is. He hums and buzzes over the clover patch. He hums and buzzes around the honeysuckle bushes in your yard.

Bumblebees live a family life, too. They live together in nests. Man does not build hives for bumblebees as he does for honeybees. Bumblebees make honey, but only enough for themselves. Honeybees make more honey than they use; so we use some of it.

The bumblebees choose old fieldmouse nests in the meadow for their hives. Early in the summer the queen bee starts laying eggs.

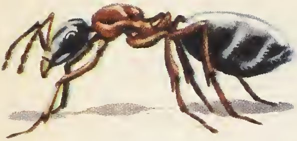
She makes beebread for the first bee babies to eat. She lays one egg on each ball of beebread. When the babies hatch, their food is right there for them to eat.

The first bees to hatch are worker bees. Very soon these young workers take over the work of gathering pollen and nectar. Then the queen lays many eggs. She does not leave the nest. She stays at home and does the work she was meant to do. She just lays eggs.

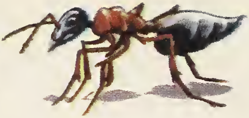
There are two kinds of workers in the bumblebee nest. The large workers gather pollen and nectar. The small workers stay in the nest and care for the young babies when they hatch.

Later in the summer drones and young queens hatch. After they mate, the drones die. The young queens sleep in their warm nests all winter.

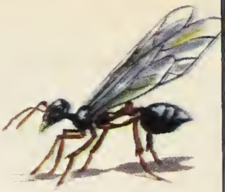
Bumblebees work together well. Each bee does his own job. But bumblebees do not plan together as your family does.



Queen



Worker



Winged male

# Ants Also Are Social

There are many other kinds of animals that live a family life besides man and bees. Ants live together in large families. They work together in the anthill. Ants are very social animals.

It is fun to watch ants at work. You can have an anthill to watch. Go for a walk with your teacher. Take a large glass fruit jar and a shovel. Find an anthill and dig down deep under it. Place the dirt and ants in the glass jar.

When you get back to school, set the jar in a pan of water, so that the ants cannot crawl away.

If you wrap a dark paper around the jar and keep it there for a few days, the ants will start working sooner. They will build tunnels along the sides of the jar. You can watch them carry the eggs, which the queen lays, from room to room.

Be sure to feed the ants you keep in the jar. Push a glass funnel down into the dirt in the top of the jar. Put sand in the funnel. Then you can drop crumbs of bread and cake and grains of sugar on the sand in the funnel. The ants will come up into the funnel to get their food. Change the sand often, to keep the food fresh. Feed the ants only every four or five days.

If your family of ants does not work, you may not have dug up the queen. So try another hill. By digging deeply you should get a queen. Your ant family will not work without a queen.

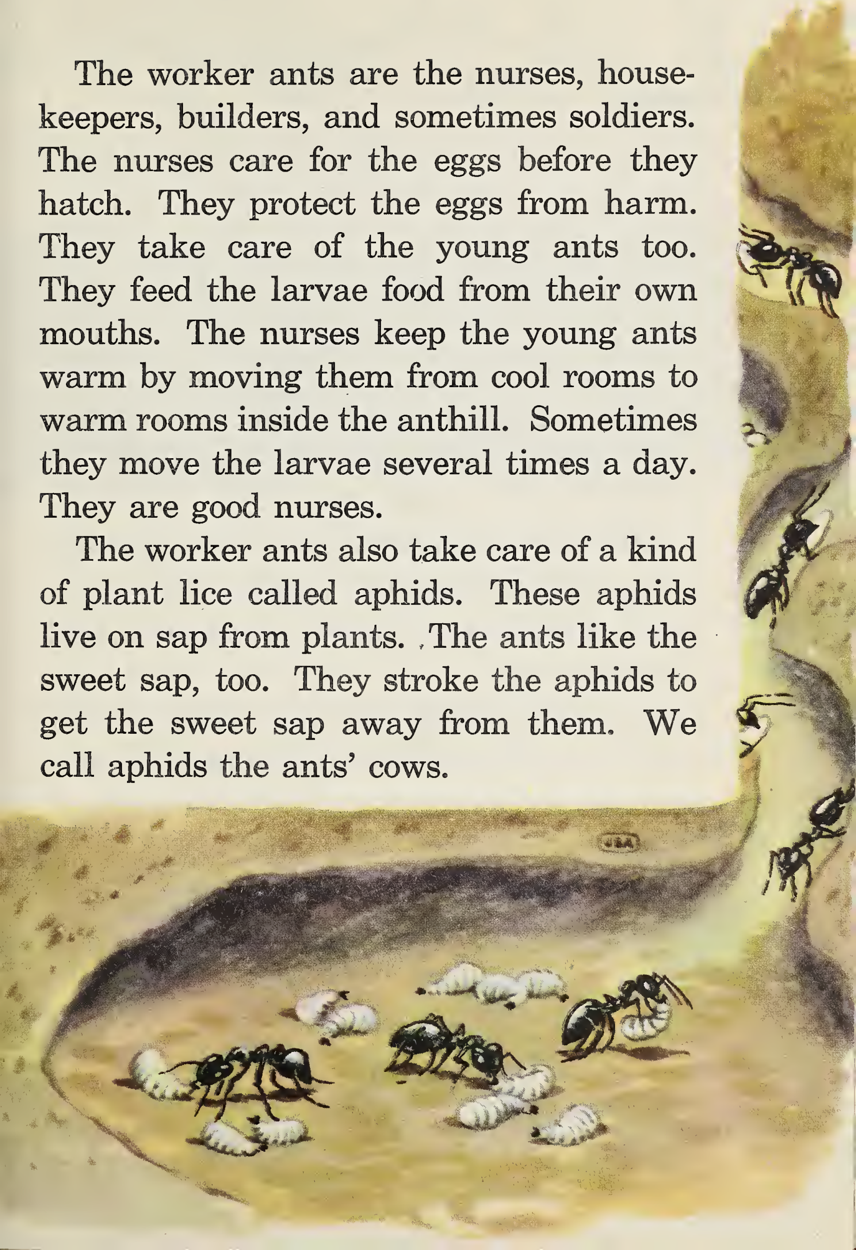
## An Anthill

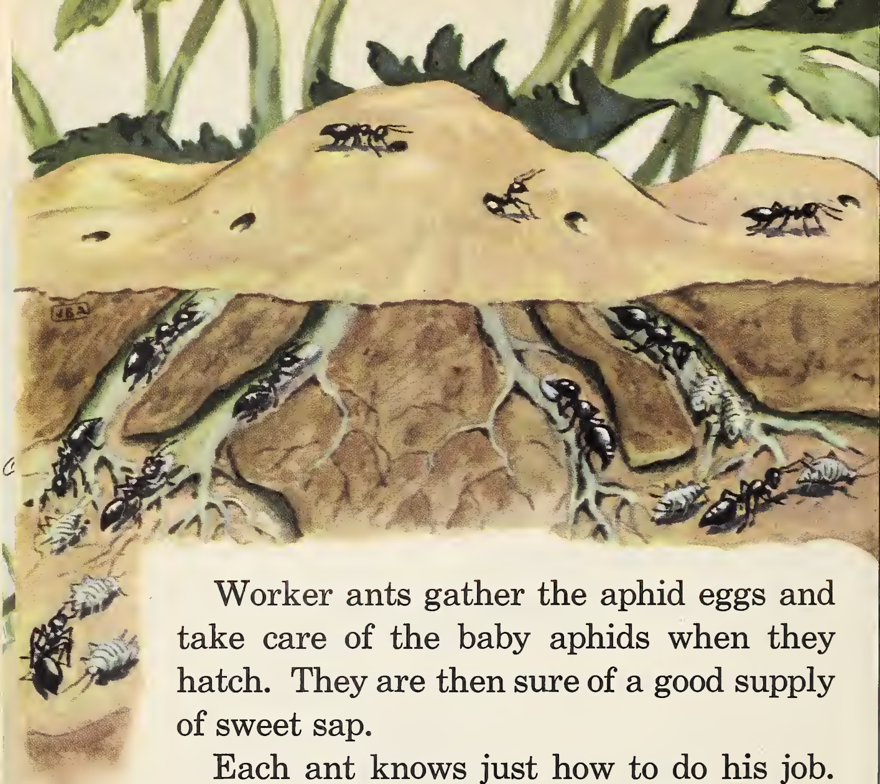
Life in an ant family goes on much as life in a bee family does. Each family has its own anthill. Each family has a queen, several males, and many workers.

Watch carefully near the last of May or early June. The young queens from the anthills in your schoolyard will fly into the air. Each queen mates with a male high in the air. She flies back to earth to make a new home. She loses her wings then.

The worker ants are the nurses, housekeepers, builders, and sometimes soldiers. The nurses care for the eggs before they hatch. They protect the eggs from harm. They take care of the young ants too. They feed the larvae food from their own mouths. The nurses keep the young ants warm by moving them from cool rooms to warm rooms inside the anthill. Sometimes they move the larvae several times a day. They are good nurses.

The worker ants also take care of a kind of plant lice called aphids. These aphids live on sap from plants. The ants like the sweet sap, too. They stroke the aphids to get the sweet sap away from them. We call aphids the ants' cows.





Worker ants gather the aphid eggs and take care of the baby aphids when they hatch. They are then sure of a good supply of sweet sap.

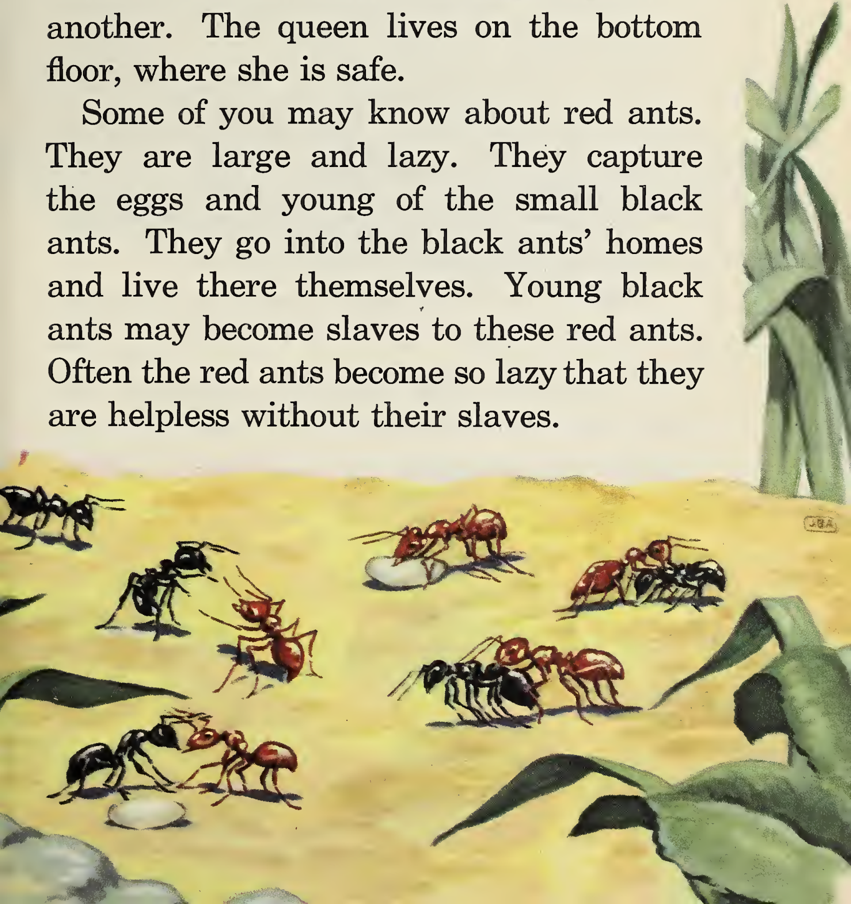
Each ant knows just how to do his job. Each ant does his work just as other ants have done that work for centuries past.

Honeybees and ants have about the same kind of family life. They are known as social animals, because they always live together in families and work for the family, not for themselves.

# Kinds of Ants

There are many kinds of ant families. The black ants are the ones you will be likely to find in your yard. Their home may be called an apartment house, because it is built with one story on top of another. The queen lives on the bottom floor, where she is safe.

Some of you may know about red ants. They are large and lazy. They capture the eggs and young of the small black ants. They go into the black ants' homes and live there themselves. Young black ants may become slaves to these red ants. Often the red ants become so lazy that they are helpless without their slaves.



The farmer ants grow gardens down inside their anthills. They grow a kind of rice and use it for food. This rice sprouts in the dark. The ants use the sprouts of the rice as food. Some farmer ants sprout seeds inside their anthills. Others grow a kind of mushroom down inside their dark homes.

The tailor ant lives in India. It does not live in anthills. Its home is made by fastening leaves together. Inside the leaf home the tailor ant lays her eggs and raises the young larvae.

Another kind of ant builds its home in posts and trees. It is the carpenter ant. These ants destroy the wood, because they dig their tunnels inside it. Man does not like carpenter ants.

Tailor ant

Farmer ant

Carpenter a

# Beavers Also Are Social

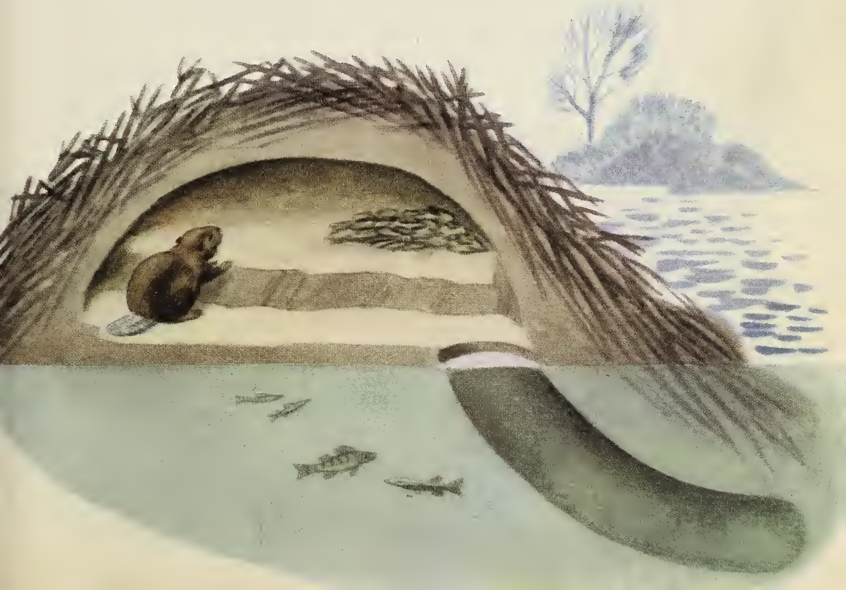
Have you ever seen a beaver dam? Beavers are family animals. Sometimes several families live together in one big pond. Each family has its own house. But there may be several houses in the same pond.

Beavers are mammals. A mammal is an animal which feeds its babies on milk from its own body. Baby beavers are born alive. At first the mother beaver feeds her babies milk from her own body. When they get teeth, they are no longer nursed by their mother. Then they eat the tender bark of young trees instead.

The grown-up beavers work together to build their dam. They build a dam to make a pond. Their pond must be deep enough not to freeze all the way to the bottom in winter. They dam the stream by using poles, sticks, and mud. Several families may help to build the dam and mend it when it breaks. These families use the pond together, but each family lives in its own lodge.

Mother and father beaver together build a lodge, or home. They build it in the pond or upon the bank. The lodges are built of sticks and mud and have two stories. The upstairs is the dry part, and the downstairs is where the beavers dry themselves before going upstairs. The doors of the lodges are underneath the water.

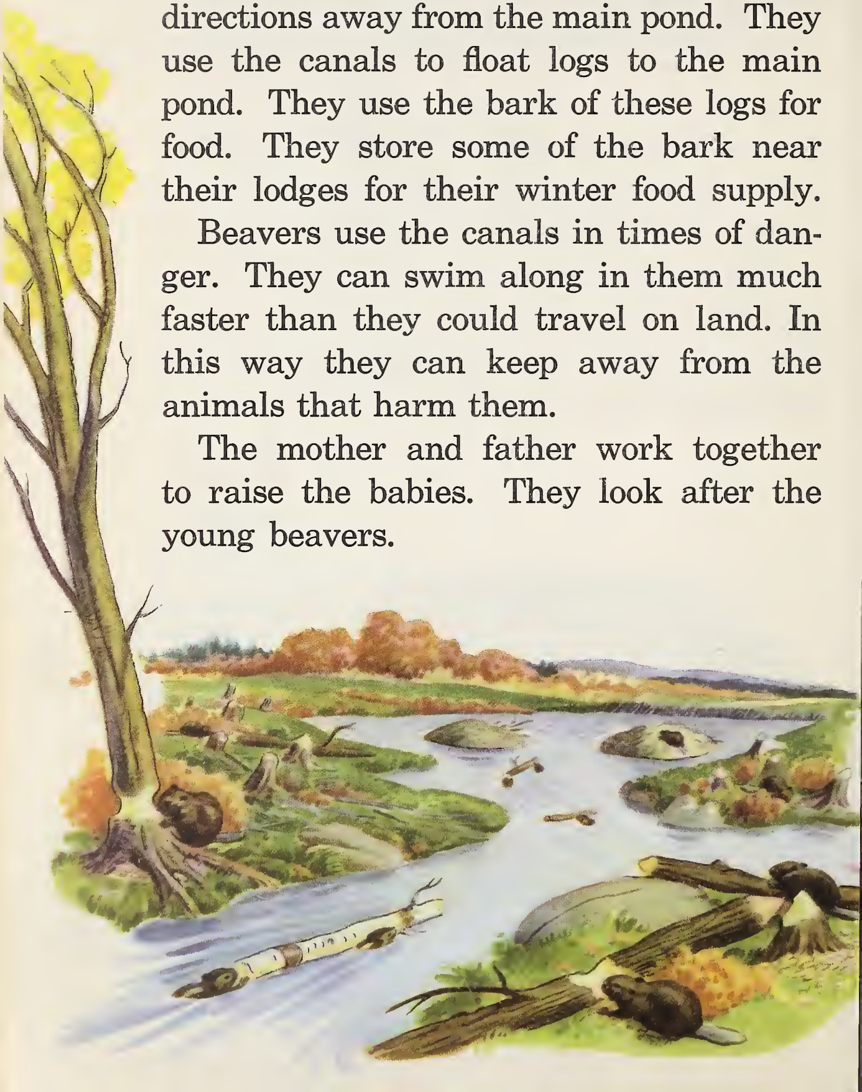
Beavers are very clumsy out of water, but move quietly and easily in water. They can swim out of danger from the fox, hawk, bear, or wolf.



Grown-up beavers in the beaver pond often build canals, or ditches, in different directions away from the main pond. They use the canals to float logs to the main pond. They use the bark of these logs for food. They store some of the bark near their lodges for their winter food supply.

Beavers use the canals in times of danger. They can swim along in them much faster than they could travel on land. In this way they can keep away from the animals that harm them.

The mother and father work together to raise the babies. They look after the young beavers.



When danger is near the mother beaver slaps her broad tail on the water. What a splash she makes! The young beavers swim away to their lodges.

Beavers are very good woodcutters. They have sharp teeth. These teeth chip the pieces of bark and wood away very quickly. The chips fly fast. In a little while the tree falls over into the pond.

Beaver families work well together. They help one another to keep the dam in repair. They help one another to gather the food supply. They help one another when danger is near. But even beavers do not plan together as our families do.

## Some Questions to Answer

1. In what ways are the animals you read about in this chapter alike?

2. Why does the queen bee need to lay so many eggs and hatch so many babies?

3. How do bees and ants keep their families alive during the winter?

4. Where would a beaver be safer, on land or in the water?

5. What other animals do you know about that have gnawing teeth like the beaver's?

6. How can you find out why ants and bees are called social insects?

7. Ants have been living upon this earth for centuries. They are such little creatures, how have they been able to keep alive so long?

8. What other kinds of social animals do you know about?

## Things to Do

1. There are other social animals for you to study. Most wasps are social. The wasps that build large, gray, paper nests are very social animals. Read about these papermakers, and find out how they live.

2. Have you ever heard about termites? They are insects that do a great deal of damage. They eat wood. They sometimes get into the foundations of buildings and eat parts of them away. Then the buildings fall down. Read to find out more about termites and how they live. They are social animals, too.

3. Compare the ways of man with the ways of the social animals you have been reading about. In what ways are they alike? In what ways are they different?

4. It is fun to watch ants work. Keep them in a glass jar in your room. Watch them build tunnels.

# How Other Animals Live

# Some Animals Live in Herds

Some animals do not live in families. They live together only part of the year. They are not like the family animals, because they do not build homes for their young. They do not take much care of their babies after they are born. And they do not teach the babies to catch their food.

Some of these animals travel in herds. They can leave the herd at any time they wish, and they can join it at any time. Often the female leaves the herd to care for her babies when they are very small.

The herd may be ruled by either a male or a female. Sometimes there are two leaders. A male leads the males, and a female leads the females. The red deer and the fallow deer form into such herds after the mating season. Have you ever seen a herd of animals following a leader?

The leader must prove that he is able to lead. A battle results. The winner is leader as long as he is strong enough. He must keep fighting for his right to be leader of the herd. No weak animal is able to be leader for long.

Animals in herds help to keep one another safe from danger. Herds of deer, buffaloes, and sheep are protected from wolves in this way. A herd of deer can kill a wolf, but one deer cannot do it alone.

Elephants live in herds. Two or three hundred may form one herd. They are led by an old female elephant. They sleep by day and hunt together at night.

Many of the animals living in cold places live in herds. They keep one another warm. They keep one another from getting too cold in the cold weather.

Did you ever notice how much warmer it is when a crowd gathers around you? It is easy to see how animals keep warmer by staying close together.

If you live where it is cold in winter, see whether animals in the zoo or the barnyard seem to stay close together. Watch a herd of cattle during a heavy snowstorm. They are able to keep warmer when they stay close together.

# Some Animals Band Together to Sleep

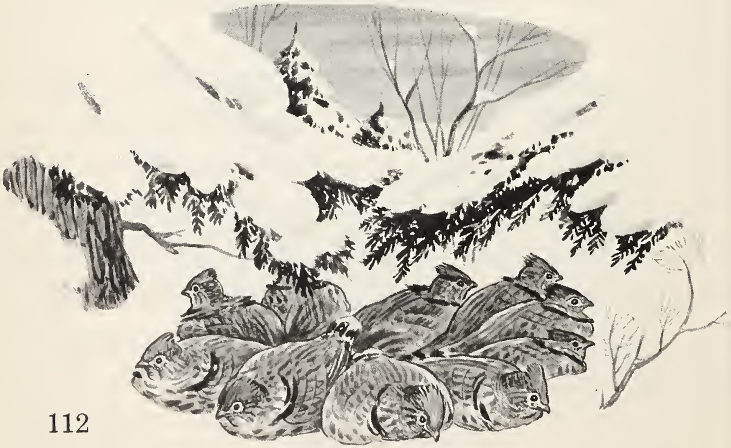
If you have ever raised a flock of chickens, you will know how close together they get at night. They will scatter about over the field for food during the day, but at night they roost close together.

Turkeys come together at night for protection while sleeping, too. If an enemy comes near, a turkey will cry out to warn the others. They make such a fuss that they all wake up and try to get away. Chickens and turkeys have many enemies that hunt at night. A cry of alarm often saves the whole flock.

Many of our birds roost together in trees or buildings for the night. A flock of partridges sleeps in a circle with heads pointing out. They help to keep one another from harm.

Chimney swifts band together at night to sleep. During the day they fly about by themselves. Hawks often sleep together during the day.

All these birds get protection in this way. Watch other birds that live near your home. Notice which ones roost together.



# Some Animals Band Together to Get Food

There are some animals that come together in the daytime to feed. At night they go by themselves again. Elk, antelope, and cattle are often seen together in a feeding herd.

Some kinds of birds join for feeding. These groups often have a woodpecker as a leader. There may be nuthatches, creepers, and woodpeckers all feeding together.

Sometimes wolves hunt together. They form in a long line. They divide into two groups. One group chases the animals to be used as food, while the other group blocks their path.

Lions sometimes hunt with their own families. Some go through the brush to scare out animals while the others jump upon the hunted animal as it runs past their hiding place.

# Many Animals Band Together to Migrate

A great many kinds of birds flock together when they are ready to move about from place to place. We say birds migrate. Many birds fly north for the summer and return south for the winter. You must watch for these migration times. When school begins in the fall, many birds will be seen flocking together. There will be great numbers of them. Then as it gets colder, you will see fewer and fewer flocks. You will know that these birds have gone to their winter homes.

In the spring you will watch the flocks return. Some of the birds will summer in your neighborhood.

The spring migration is more fun to watch than the fall migration. In the spring many birds are beautifully colored. By fall their colors have changed so that you might not know them as the same birds.

Robin

Some birds travel great distances. The bobolink travels from New York to Brazil, a distance of 2500 miles. The arctic tern travels a distance of 11,000 miles as it migrates from the Far North to the Far South.

Bluebird

Other animals migrate, too. Eels travel from Europe and North America to lay their eggs near Bermuda. They leave the rivers and lakes where they live. They migrate to the sea.

Bobolink

Arctic tern

Salmon come together to migrate. They travel up the swift streams to lay their eggs. The hardships which the salmon stand in working their way up streams are a wonder to us. They battle the swift waters of the stream. After they have laid their eggs, they die.

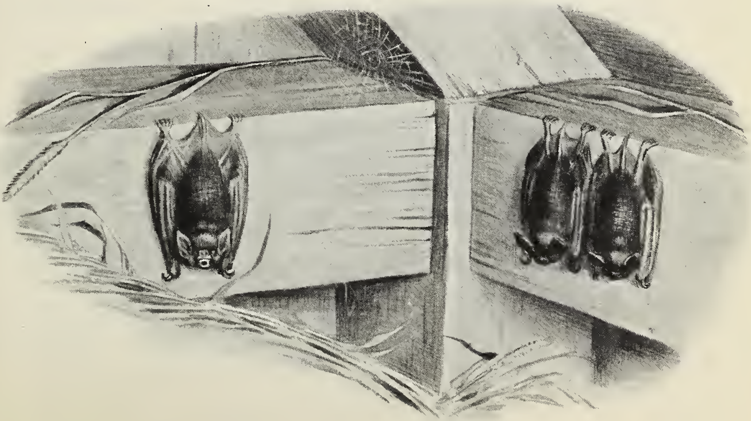
The reindeer of the Far North migrate in herds. They go to look for new places to feed. Sometimes they travel in great herds for hundreds of miles.

Whales band together to migrate to the places where they raise their babies. They travel far out to sea together. Seals, sea lions, and walruses spend most of their time in the open sea. They come to the land to have their babies. Then the herds all go back to the sea again.

# Some Animals Band Together to Hibernate

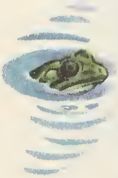
Some animals band together to hibernate, or sleep during cold weather. Rattlesnakes sleep together in rocky places. In the spring they wake up and crawl off alone again. Have you ever found a whole family of snakes under a log in the woods? They have slept there all winter.

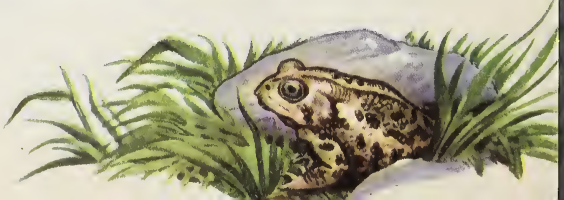
Little brown bats hibernate in caves and in barns during the winter months. There are mosquitoes in Kentucky which hibernate in caves during cold weather.



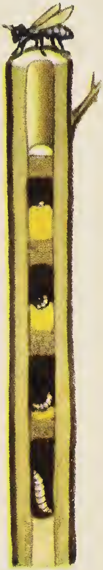
## Some Animals Live Alone Almost All the Time

There are many animals that live alone most of their lives. These animals go their own way, getting food wherever they can. They have almost no family life. They live together for only a short time, while they mate. Frogs, toads, lizards, alligators, crocodiles, fish, and many insects are some of these animals. These animals are sometimes called solitary animals. They live alone except at mating time.



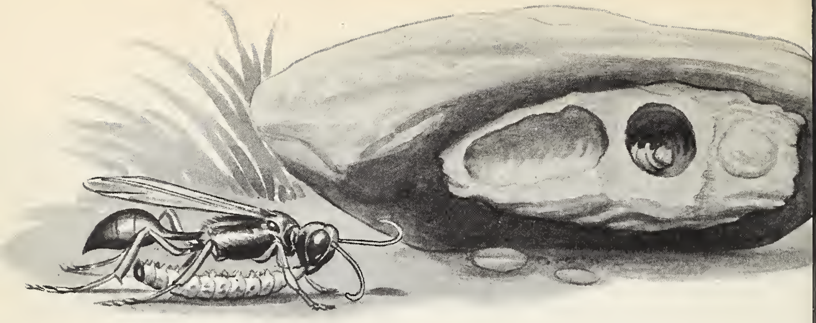


Some bees live alone almost all the time. They come together only to mate. These bees are called solitary. They build their nests in the ground, in plants, or in holes in walls or trees.



The bee that almost always lives alone builds a row of cells like those you see in the picture. In each cell she places a ball of beebread and an egg. When the young bee hatches it eats the beebread.

The mason bee builds its nest of clay. It fastens the nest to stones in a field. After the cells have been built, the bee gathers pollen for beebread and nectar for honey. Then she lays her eggs. She builds a thick cover over the top of the nest to protect the eggs.



Some wasps live alone most of the time. They come together only to mate. The mud-dauber wasp builds her nest of stones and mud on the ground. There are several rooms in the nest. She puts a caterpillar in each room. She hunts the caterpillars, poisons them, and pulls them home. Then she lays an egg on each caterpillar and shuts the door of each room. When the babies hatch, they have plenty of food to last them until they can hunt for themselves.

The cicada-killer wasp lives alone, too. It builds a nest under the ground. The wasp puts cicadas, often called locusts, in the nest for the babies to eat when they hatch.

Some animals are seen together, but not because they help one another. They are together for other reasons. Most butterflies feed together in gardens. They come there because of the smell of the flowers from which they get their food.

Many other insects are together because their eggs have been laid in the same place. You may have seen May flies, hundreds of them, flying together over a lake. They are together only because their eggs happened to be laid on that lake. They do not help one another.

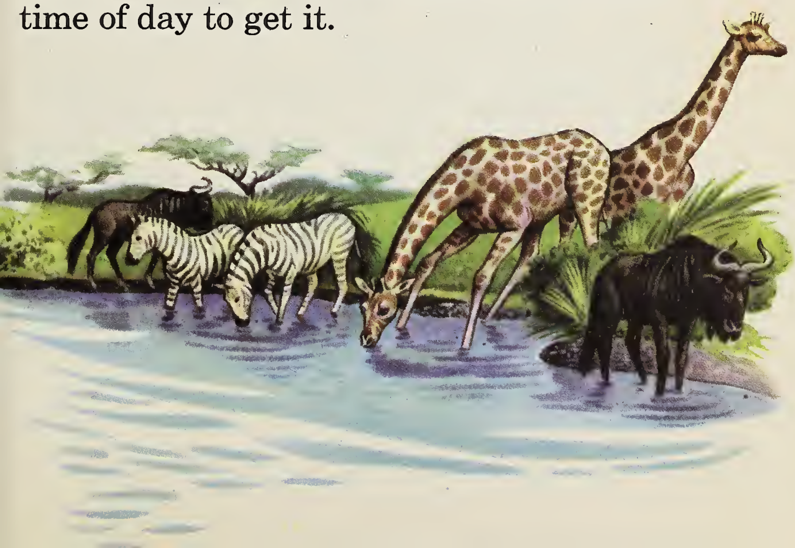
This kind of group is quite different from a herd of deer feeding together or a hill of ants working together. Can you see that it is? The May flies are in the same place by accident. They do not stay together. They are likely to separate. The deer are together because being together protects them.

Go to a pond on a sunny day. You may see a number of turtles sunning themselves on the same board or rock which sticks out of the water. You may think that this is a flock, or school, of turtles; but that is not true. They are together only because they happened to see that place to sun themselves. Each one crawled up. When there was no more room, the ones that came late crawled on top of the others.

Crocodiles and alligators do the same thing. They are together because they just happen to find the same place in which to sun themselves. Snakes gather in stony places for the same reason.

Frogs often sit together upon logs and pond lilies to sun themselves. Each one comes there alone, and each one leaves alone when he is ready to take a dip into the water.

You often see pictures of animals around a water hole during the dry times of the year. They are there only to get water. They just happen to be there at the same time of day to get it.



Cabbage butterflies are sometimes seen flying together in the garden. These butterflies are together quite by accident. They have come to the garden because the cabbage and other vegetables attract them.

Mosquitoes are often found together in great numbers. They live in places where water stands still a long time. They are not a family, as bees are. The mosquitoes are thick in these places because the eggs from which they hatched were laid all together in the water. When the larvae hatched, there were many of them growing up right near each other.

Do houseflies gather on the screen door of your kitchen? In the fall you can sometimes find a hundred or more flies waiting to get into the kitchen. They smell the good food that is cooking inside. But these flies do not belong to a family. They are together quite by accident. They were attracted to the kitchen door by the smell of food cooking in the kitchen.

# There Are Advantages in Each Way of Living

You have read about many animals that live a social life. You have also read about other animals that live a solitary life. Have you been wondering whether there are advantages in both of these ways of living?

We cannot tell whether one is better than the other. Each way has some things about it that are good. Each way has some things about it that are not good.

It is easier for animals to store food and protect their young when they work together. Most of the social animals eat plant food instead of meat. They work together to gather and store their food. Many of the solitary animals eat meat. They hunt alone for meat. They do not store their food for long, because meat will not keep.

When animals are very social, they often learn to depend upon one another. The drone bee cannot feed himself. The workers have to feed him. Some ants die if their slaves die.

Sometimes there is not enough food for the animals. There may have been a cold time or a very dry time of the year. At these times it might be better to be a solitary animal. Social animals might use so much of one kind of food that it would become very scarce. They might have to travel a long way to get enough food to feed all of their family.

Men have probably always lived together. They have worked together for many centuries. It would be very hard for man to live alone. It would be hard for many animals to live alone, too.

Each way of living has advantages. Each way has disadvantages.

## Things to Do

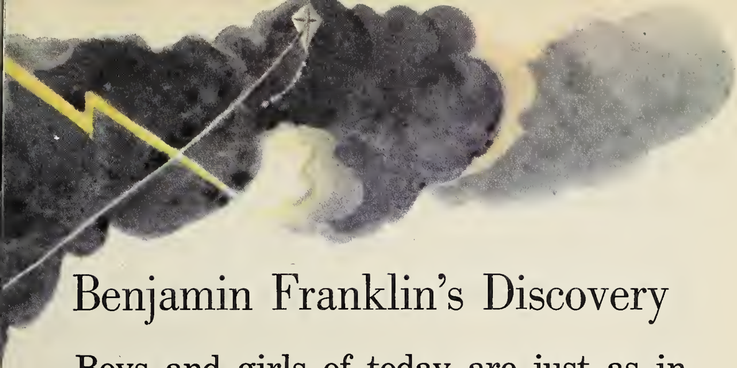
1. Go for walks into the fields or parks and watch animals there. Notice how they work together to get food and to take care of their babies.

2. Make a list of all the advantages of social life. Make a list of all the disadvantages of social life.

3. You may want to make pictures of the many ways animals live and work together. Choose one animal and make a picture showing his kind of life. If each child in your class makes one picture, you might put them together on your science bulletin board.

4. Watch the birds return in the spring. Make a calendar for the month of April. Record the names of each bird you see. Record it on the date when you first see the bird. Draw a picture of each bird you see and put it on your calendar.

# Electricity and Magnetism



# Benjamin Franklin's Discovery

Boys and girls of today are just as interested in thunder and lightning as boys and girls were many years ago. We like to watch the flashes of light zigzag across the sky. We listen for the rumbling of the thunder that follows.

Today boys and girls know what lightning is. They know it is really electricity. But many years ago boys and girls did not know what lightning was. They often asked their parents, who could only answer, " We don't know."

About two hundred years ago Benjamin Franklin found out what lightning is. He did a very dangerous experiment to find out. You should not try to do this experiment.

He fastened a key to the end of a long kite string. In one hand he held a piece of silk ribbon. In the other hand he held the kite string. He took his kite out during an electric storm. The string of the kite got wet with rain. It carried the electricity from the lightning down to the key. Sparks jumped from the key to the hand that held the silk.

That was all Benjamin Franklin needed to know. He had proved for all of us that lightning is electricity.

## Jane's Discovery

"Mother," called Jane one cold day, "come quickly! Something is wrong. My hair sticks straight up when I comb it."

Mother was amused. She knew what the matter was. Jane was making a discovery. She was making electricity.

"I hear a crackling sound too, Mother. What is that?"

" Let's go into this dark closet a minute," said Mother. " Bring Richard too."

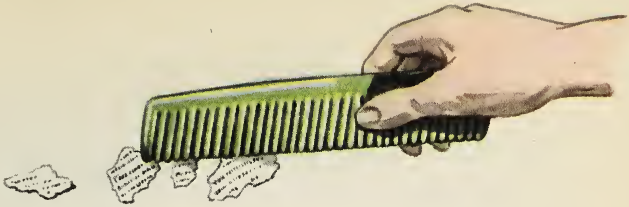
Jane combed her hair in the dark. She looked in the mirror on the closet door. She saw tiny sparks as she combed. She heard that crackling noise again. Then Jane tried combing Richard's hair. The same thing happened.

Mother explained electricity to Jane and Richard. She said that many objects make electricity when they are rubbed. That is what Jane's hair did when she rubbed it. Part of the electricity went out of Jane's hair and into the comb. We say an electric spark was made. The crackling noise was like the noise of thunder that follows a flash of lightning. Only the spark was so tiny that the noise was only a tiny crackle.

# Making Frictional Electricity

It is fun to make electricity with your cat. You can do it if the room is warm and the air is dry. Stroke the cat's fur from the tail toward the head. You will feel the electric shock. You will hear the crackle. If the room is very dark you will see tiny flashes of electricity. We call this frictional electricity, because it is made by rubbing one object with another.

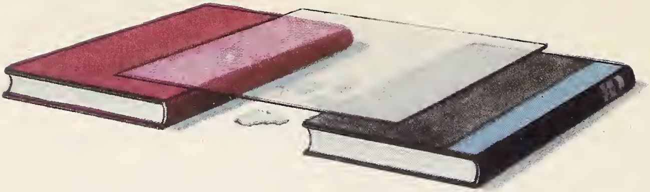
Did you ever get a shock? Perhaps on a cold day you have slid your feet along the living-room rug. Then when you touched the metal doorknob you got a shock.



Really what you did was to make a little frictional electricity. You made it when you slid your feet across the rug. You felt the shock when you touched the doorknob.

Try this and see what happens. Tear some newspaper into small pieces. Lay them on the table. Now stroke your comb or your fountain pen with some woolen cloth. Bring the comb near the pieces of paper. What happens? You really make electricity. This electricity makes the pieces of paper stick to the comb.

Sometimes when you are writing on a piece of paper on your desk it sticks to the desk. You have to pull the paper away from the desk. While you were writing your arms rubbed across the paper. The rubbing made electricity. Electricity made the paper stick to the desk.



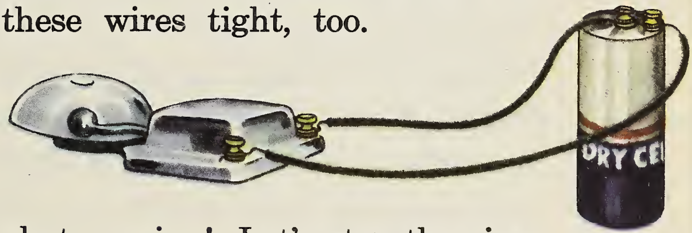
If you have a piece of glass about the size of this book, you can do another experiment. Lay two books on the table. Leave a space between the books. Now lay the glass across the space from one book to the other. Put a few tiny pieces of paper under the glass. Rub the top of the glass with a dry silk cloth. Why do the pieces of paper come up to the glass?

In the experiments you have been doing, electricity was made by rubbing things together. You rubbed the cat's back. You rubbed your shoes against the carpet. Scientists call the electricity we get by rubbing things together frictional electricity. They have known about this kind of electricity for a long time. Benjamin Franklin proved that lightning was really frictional electricity.

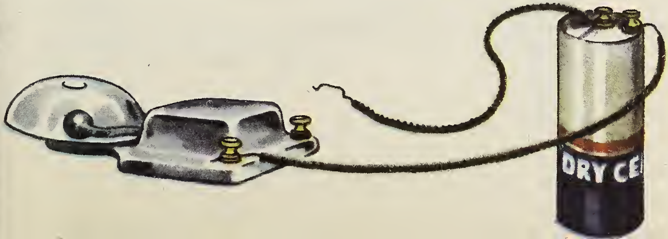
# What Makes the Bell Ring?

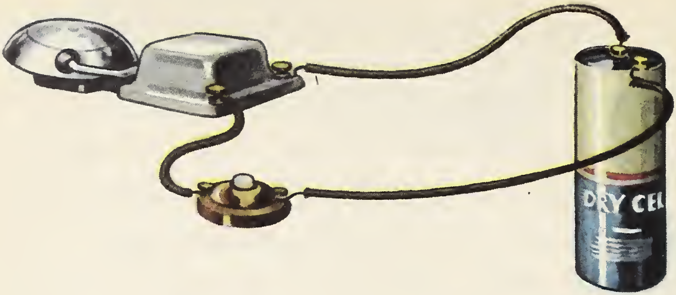
Let's wire a bell and see if we can find out what makes it ring. You will need a dry cell and a bell. You will need two pieces of wire which are covered with cotton cloth. We call this kind of wire insulated wire. The covering is called insulation.

Scrape the insulation off the ends of the wire. Connect one end of each wire to the posts of the dry cell. Screw the wires down tight to the posts. Connect the other end of each wire to the posts of the bell. Screw these wires tight, too.



My, what a noise! Let's stop the ringing. You can stop it by taking one end of the wire away from the post.





There is an easier way to stop the ringing bell. Let's use a push button.

Cut one of the two pieces of wire in two. Scrape the insulation away from each end. Connect these two free ends to the posts of the push button. Press the button. Does the bell ring now?

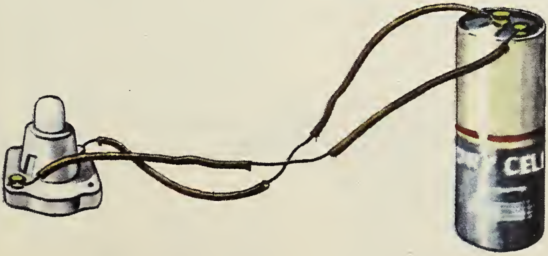
When you press down upon the push button, you make a complete path, or circuit, which electricity travels along. Electricity travels from the dry cell along the wire to the bell and back through the other wire to the dry cell. When you do not press upon the push button, the path is not complete and the bell cannot ring.

# What Is a Short Circuit?

Sometimes there is a short circuit and the lights go out in your house. This will explain how it can happen.

Wire a light to a dry cell. Have a complete path along which the electricity may travel. Now scrape the covering off the middle of each wire. Cross the wires at this point. Does the light go out?

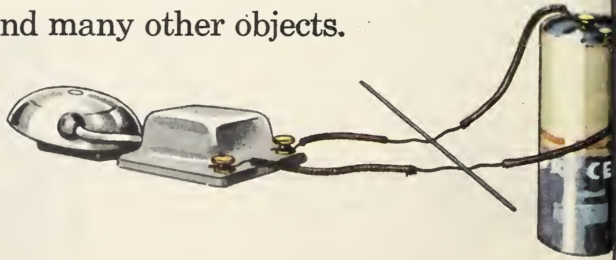
Electricity will always travel along the shortest path it can find. When you crossed the two wires you formed a short path, or short circuit, along which the electricity traveled. None of the electricity went into the light. The light did not go on because the electricity took the short circuit back into the dry cell.



# Paths for Electricity

Some things make good paths along which electricity may travel. The copper wire you have been using in your experiments makes a good path. If you cut the copper wire, the bell stops ringing. There is air between the cut ends of the wire. Electricity is not able to travel along an air pathway.

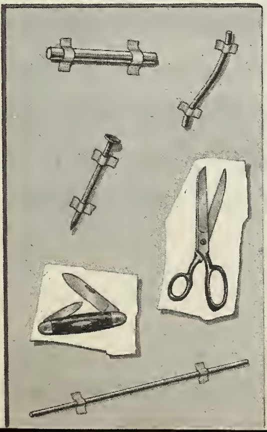
We say that some things conduct electricity better than other things. Copper wire conducts electricity better than iron wire does. Let's see what some other good conductors are. Lay a steel knitting needle across the wire just as you see it done in the picture. Will the bell ring now? Try a piece of chalk. Try the blade of a jackknife, a piece of cloth, a gold ring, an iron nail, and many other objects.



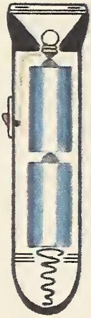
You might like to keep a record of the results of your experiments. Make two charts on large pieces of paper. On one chart show the objects that are poor conductors of electricity. On the other chart show the objects that are good conductors. Either fasten the object itself on the chart or paste on a picture of it.

Be sure you do the experiment with each object you put on the chart. You should not guess about whether copper wire or chalk or glass or gold or scissors are good conductors. You can be sure of your facts. If the bell rings, you will know that you have put a good conductor across the bare parts of the wire.

Good Conductors



Poor Conductors



# Lighting a Flashlight

Many of you use flashlights. Someone may have a flashlight at home that does not light any more. Why not take it apart and look inside it? See if you can find the circuit along which electricity travels.

At one end is the light bulb. Next to it are one, two, or three dry cells. These cells have only one post showing on top. The zinc covering of the cell acts as the second post.

Look at the two metal strips that run along one side of the flashlight. These strips of metal are like the wire in your bell circuit. Now press on the switch. This switch is like a push button.

As you push on the switch, do you see that it makes the two strips of metal touch each other? The electricity can now travel in a complete path from the dry cells along the metal strips, through the light bulb and then back into the dry cells again.

# Machines That Use Magnets

Today there are many machines that run by electricity. Many of the electrical machines work because they have magnets in them. The telephone and doorbell work because of electricity and a magnet.

We call the magnets in these machines electromagnets, because they can be turned on and off by electricity. These machines are very important to all of us today. Yet for thousands of years men did not know about them. Man has known about magnets, however, for many thousands of years.

Long ago the Greeks mined iron which would attract other pieces of iron to itself. The Chinese used chips of this magnetic iron in their compasses.

Man has also known about electricity for a long time. But it was not much more than one hundred years ago that he learned to use magnets and electricity together.

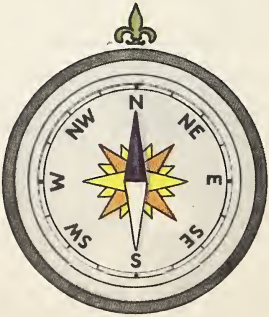
# The Compass

At one time or another you must have had fun with magnets. Perhaps you have experimented to see just what kinds of things a magnet will attract.

Did you ever try to pick up nails with your magnet? Did you ever try to pick up tacks with your magnet? Will a magnet pick up paper? Will a magnet pick up a nickel or a dime?

If you have a magnet at school, use it. Try to find out just what things a magnet will attract.

Many children like to watch a compass work. It works because the needle inside it is a magnet. Something attracts the compass needle and makes it work.



Have you ever watched a compass work? There are letters on the compass face. These letters are N, S, E, and W. They stand for the directions north, south, east, and west. North is at the top of the compass.

Hold the compass in your hand. As you hold it, the needle of the compass moves. It moves back and forth. Hold the compass still and level. The needle soon stops moving. Notice in which direction the blue tip of the needle points.

Now take the compass to another part of the room. Hold it still and level. Notice in which direction the blue tip of the needle points now. Does it point in the same direction it did before?

Take the compass to many different places. You will see that the blue tip of the needle always points in the same direction. That direction is north.

Do not go near the radiator. The metal radiator will attract the compass needle.

Now move the compass so that the letter N is right under the blue tip of the compass needle. The blue tip of the compass needle tells you where north is. Can you now find which way is south? Can you tell which way is east and which way is west?

Why don't you make a compass for yourself? You will need a big darning needle, a magnet, a cork, and a pan of water.

Stroke the ends of the needle with one end of the magnet. Be careful to stroke the needle in the same direction each time.

Test the needle to see whether it has become a magnet. Will it attract a paper clip or another needle? If it does not attract these objects, stroke it some more.

Now stick the needle through a thin piece of cork. Put the cork into the pan of water. Watch what happens.

Does the cork swing back and forth? Soon it will stand still. Your needle will point north and south, just as a real compass needle does.

You may wonder whether this needle will point in the same direction when it is in some other part of the room. Dip the end of the needle that points north into blue paint. Let the paint dry. Put the cork back into the pan. Take the pan of water to the other side of the room. Does the blue tip of the needle point toward the north from here?

Take your compass over beside the steel radiator. What happens to it? Does the compass needle point north now? Your compass needle will not point north and south if you get it too near iron or steel objects in your schoolroom.

Try this. Put your compass near the steel blade of your jackknife. Does the needle of the compass turn toward it?

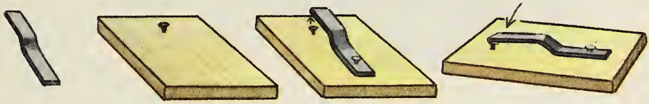
Compasses are very useful. They have been used for many hundreds of years. Columbus found the compass very helpful when he was sailing to America. All seamen find the compass very necessary when making voyages.

Boy Scouts and Girl Scouts use the compass to find their way in the woods. It is wise to carry a compass with you when you are going on a long hike.

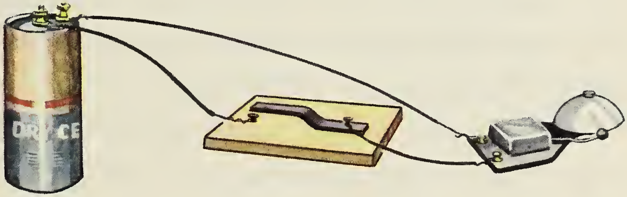
Remember you can always know directions if you have your compass with you. You can find north. When you are facing north, south is at your back, east is toward your right hand, and west is toward your left hand.

# Things to Do

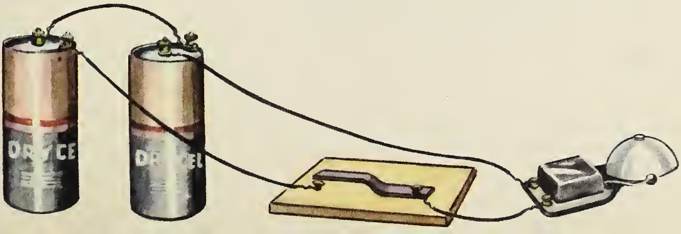
1. You may not have a push button in your schoolroom. You can make one in this way. Bend a thin piece of iron as shown below. Pound a nail into a board. Now nail the piece of iron to the board.



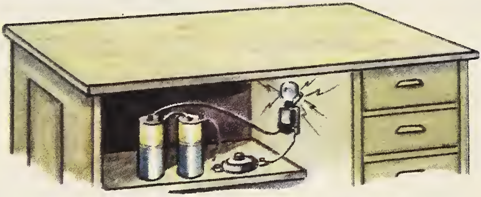
Wire the cell to the nails and the bell as shown below. Every time you push on the strip of metal the bell will ring. Do you know why?



2. You may want to use two dry cells instead of one. Two will make your bell ring louder. Do it in this way:



3. You may want to wire a bell for your teacher to use on her desk. She can ring it whenever she wants to speak to you about something. Do it in this way:



4. Could you wire a bell on a boat so that the captain could signal the engineer?

5. Could you wire a doorbell for your mother?

6. Could you wire a bell from your room into your brother's or sister's room so that you could signal to each other?

7. Could you repair your mother's flashlight if you could get new dry cells?

8. Make a list of all the ways your mother uses electricity in your home.

9. Make another list of the ways it is used outside your home.

10. Suppose you could put yourself back in your great-grandmother's home. How would she be using electricity?

11. Thomas Edison was a famous scientist. He spent many years working in his laboratory. He worked to find out more about electric light. Read about Edison's work. Find out about the electric-light bulbs he invented.

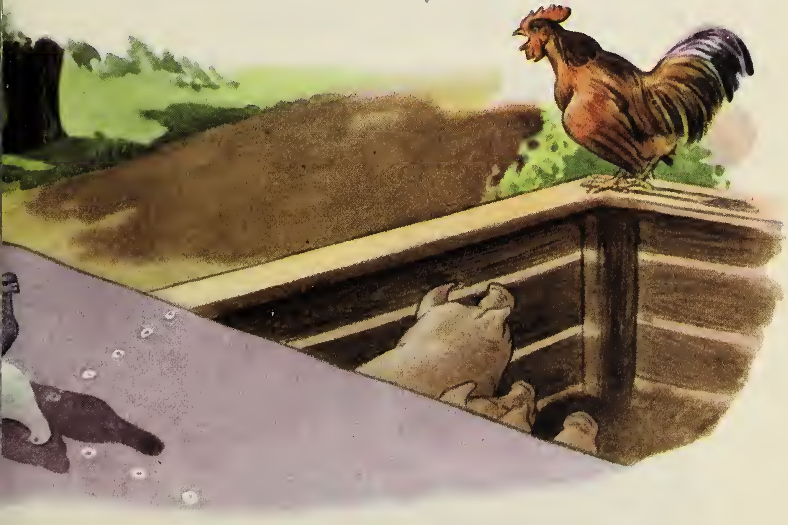
12. There have been many kinds of lamps used to light homes. You may be interested in finding out about some of the early kinds of lamps. Read to find out about the Roman clay lamp, the Roman bronze lamp, the old stone lamp, candles, the Betty lamp used by the Pilgrims, the oil lamp, and the gas lamp.

# The Sun and the Moon

# How Our Sun Shines

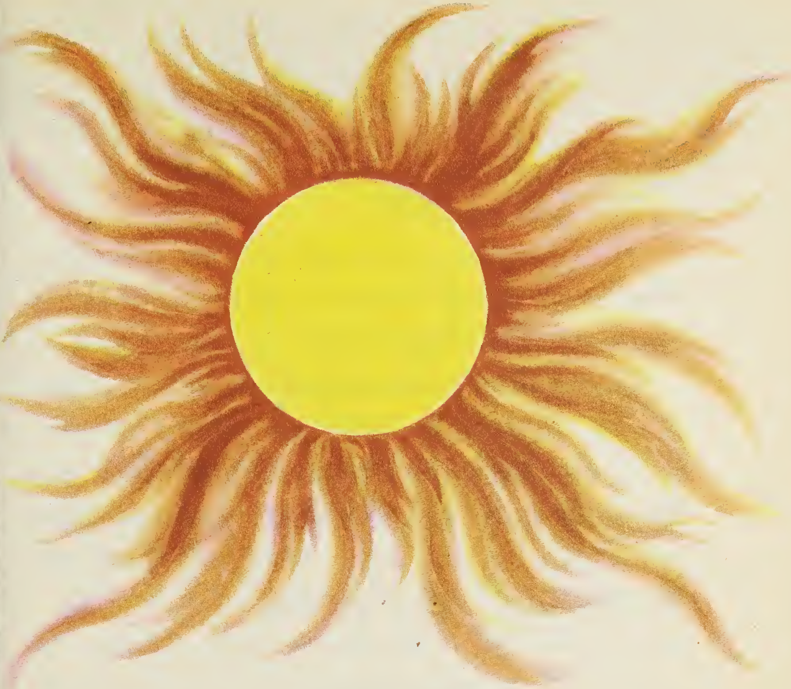
Many boys and girls have wondered how our sun can shine. Have you? No one has ever been there. But scientists have studied the sun. They can tell us many things about our sun.

Scientists know that our sun is made of gases. You know what a gas is. You know that the air you breathe is a mixture of gases. The balloon you buy on circus day is full of gas. The big navy blimps are filled with gases.



Scientists tell us that the gases of the sun are very, very hot. They are so hot that they glow with heat. You have seen the wires in your electric toaster glow with heat when your bread is toasting. You have seen the glow of a dying fire in your fireplace after the flames have gone out.

The wires of the toaster glow with heat. The embers of the fire glow with heat. The gases of the sun glow with heat, too. The toaster makes a tiny glow. The dying fire glows only a little. The very hot gases of the sun glow very brightly.



Every scientist knows that the gases of the sun are ever so hot. He knows this because the sun glows so very brightly. The glow from the sun lights our earth. The glow from the sun also lights the moon. The glow from the sun heats our earth. And the glow from the sun heats the moon.

# Suns in the Nighttime Sky

Have you ever tried counting the suns in the nighttime sky?

You may be surprised at this question. You may think there is only one sun in the sky. This is not true.

Every star in the nighttime sky is really a sun. There are millions of suns. Some of these suns are much larger than our daytime sun. Some of them are about the same size as our sun. Many of them are much smaller than our sun.

We like to see the many suns shining at night. They are beautiful to look at. They make us think of fairyland.

Some nights we can see no suns in the sky. They are hidden by thick clouds. We wish the clouds would go away so we could see the suns again.

But whether we can see the stars or not really makes but little difference to us. They do help a few people at night. The stars help the sailors at sea. They help them to find their way. They also help pilots of airplanes to find their way at night.

These many suns are far, far away from our earth. They give us only a little light. They give us almost no heat at all. They just look pretty in our nighttime sky.

# Stars in the Daytime Sky

Have you ever tried counting the stars in the daytime sky?

You may be surprised at this question too. You may think there are no stars shining in the daytime sky. This is not true.

The stars shine all night. The stars shine all day. In fact all the stars shine all the time. They never stop shining.

Why can't you see the stars shining in the daytime sky? It is because our sun shines so brightly. And the reason our sun appears so bright to us is because it is so near the earth.

Near, you say! Yes, near compared with any other star in the sky. The sun is ninety-three million miles away. That is really a long, long way off. The next nearest star is many, many millions of miles farther away from the earth.

Many of these other stars glow as brightly as the sun. But they are so very, very far away that only a little of their light reaches the earth. That is why some children think the stars go away during the day.

During the day the light from our sun is so bright that no other stars can be seen. During the night the sun does not shine on our part of the earth. In the dark nighttime sky you can see the light from the many other suns.

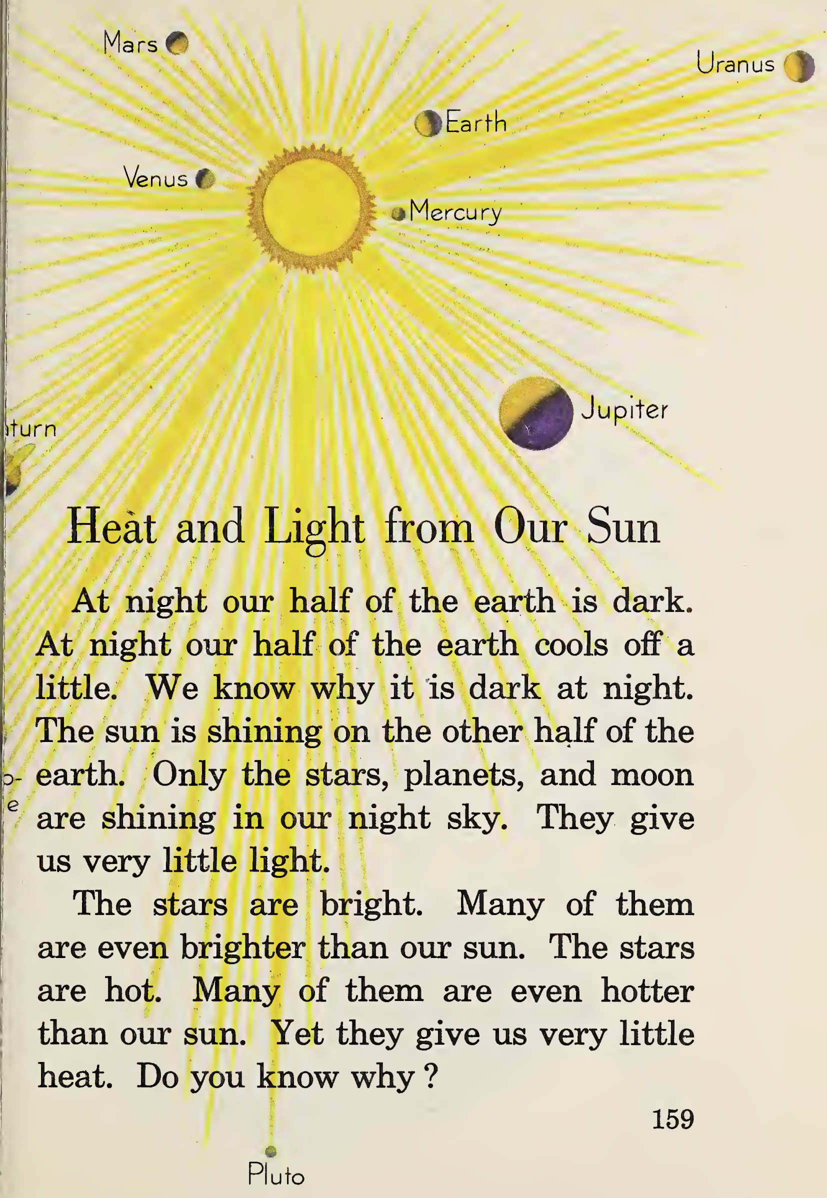
# Our Most Important Star

Our sun is our important star. It gives us heat and light. Life upon this earth would be quite different if it were not for our sun. In fact, there would be no life as we know it upon this earth if it were not for our sun.

The other suns in the sky really make very little difference to us. They are so far away, very little of their heat and light reaches the earth. We could live without them. We would miss their beauty at first. But in a short time most of us might even forget all about them.

Our sun is good for plants. If it were not for the sun, green plants could not grow. There would be no green leaves on our plants if the sun did not shine.

Our sun is good for us. Its rays help to keep us well. We could not keep healthy if our sun stopped shining on us. We could not live without our sun.



# Heat and Light from Our Sun

At night our half of the earth is dark. At night our half of the earth cools off a little. We know why it is dark at night. The sun is shining on the other half of the earth. Only the stars, planets, and moon are shining in our night sky. They give us very little light.

The stars are bright. Many of them are even brighter than our sun. The stars are hot. Many of them are even hotter than our sun. Yet they give us very little heat. Do you know why?

This may help you to understand why our nights are cooler than our days. Try holding your hand just over your mother's toaster. You can feel the heat from the hot wires. Now pull your hand farther and farther away. Does your hand get cooler or warmer as you pull it away? Try holding your hands near the screen in front of your fireplace. Now step farther away. Do your hands get as much heat as they did?

So it is with the heat from the stars. They are such a great distance from the earth that they heat it only a very, very little.

In the daytime our sun heats our half of the earth. It is nearer to us than the other stars are. It gives us more heat than the other stars give.

Yet only a small part of the heat of the sun reaches us. Only a very small part of the light of the sun reaches us. The sun sends heat and light out in all directions. We get only the part of the heat and light that comes in our direction.

It is a good thing that the earth does not get all the sun's heat and light. Our earth would then be very, very hot. We would not be able to live as we now do. Our life would be very different. Maybe there would be no life upon the earth at all. The earth would be so very, very hot.

# Let's Suppose

Let's suppose! Sometimes it's fun to suppose about things. Just suppose you go to bed as usual on a night in June. In the morning your alarm clock rings at 7:30. You look out of the window. It's still dark. You look at the clock. It is now 7:45. Something is wrong! It's still dark. You go to your mother's room to look at her clock. By now it is eight o'clock.

" Oh, well, it must be a cloudy, foggy day," you say, and walk to the window. You are surprised to see no fog. The sky is clear. The stars are shining.

" Stars at 8 : 15 ? " " Where's the sun ? "

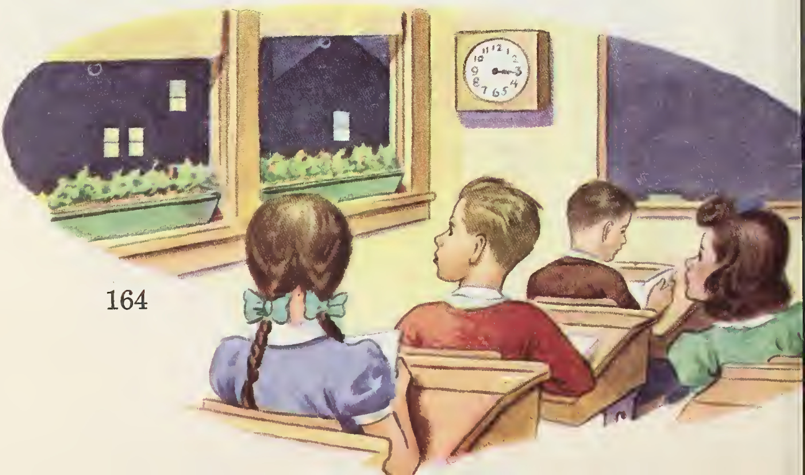
All day long you wait for the sun to show itself. You go to school in the dark. The street lights are on. Cars have their headlights on. The school lights are on.

The sun doesn't shine all that day. It doesn't shine the next day, or the next, or the next. Every time you look into the sky you see only starlight. Even the moon has disappeared.

You are surprised at how cold the air feels. Each day it gets colder. Your fingers tingle. Frosts come, although it is only June.

Pretty soon the plants start dying. Their leaves turn white and fall off. Your mother goes to the store to buy green vegetables. The storekeeper says that there are no green vegetables. He says the sun will have to shine again soon or everyone will starve.

All the doctors look worried. Children begin to look pale. They get sick. The doctors shake their heads and say, "Can't do much for the children until the sun shines again."



Sunshine keeps children strong. Sunshine makes green plants grow. Children need green plants to eat.

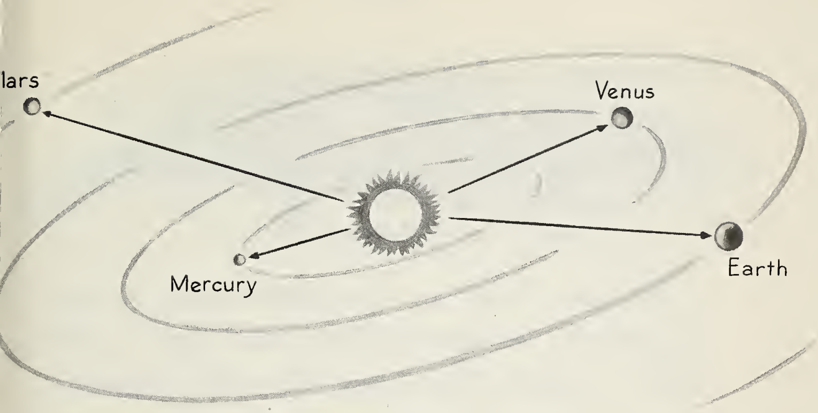
Have you supposed long enough? Let's have the sun shine again in the daytime sky. The earth gets warmer. The green plants start growing. The children begin to get the color back in their cheeks. The cows start giving milk again. The chickens lay more eggs. Every living thing upon the earth is better off because of the heat and light that our sun gives.

# The Earth's Nearest Neighbor

Have you ever seen the moon when it looked very near the earth? Sometimes when the moon is full and round it looks just a little way up in the sky. It seems very near us. It is so bright and round.

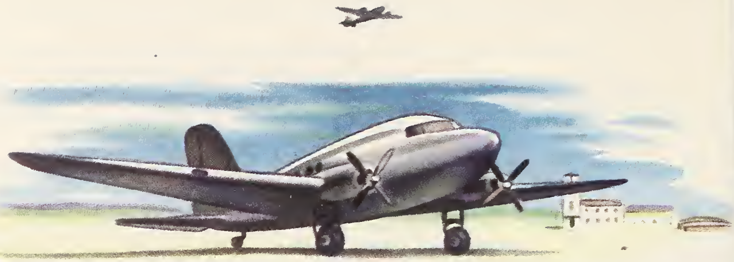
The moon is the earth's nearest neighbor. Your nearest neighbor may live just across the street or just over the hill. The earth's nearest neighbor is about 240,000 miles away.

Have you ever taken a trip that long? If you traveled around the earth ten times at the equator, you would travel about 250,000 miles. Have you ever done that?



When scientists speak of near neighbors in the sky, they do not mean the same thing that you do when you are speaking of the family that lives next door.

The sky is large. The stars and planets and moons in the sky are many, many thousands of miles apart. Some of them are many millions of miles apart. Around each star and planet and moon there is ever so much space. This space just goes on and on. Every so often out there in this great big space there is a planet or a star or a moon. Sky neighbors are very far apart.



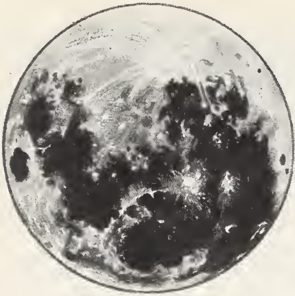
As you look at the full moon in the night sky it seems to be as large as the sun. This is not true. It only seems as large as the sun because it is so near the earth.

The moon is very, very small compared to the sun. It is even small compared to the earth. And all of you know that the sun is many times larger than our earth.

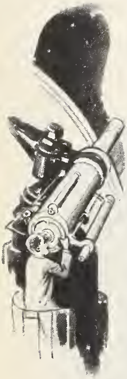
You know that big things look tiny when they are far away. An airplane looks pretty big when you stand right beside it. But this same airplane looks smaller and smaller as it flies higher and higher. That is the way it is with the sun and the moon. The sun is so very much farther away that it looks no larger than the moon. But it is many, many times larger.

# How Does the Moon Shine?

Look at the round silver moon in the night sky. It shines down upon the earth. What a lovely silvery light it makes! It is easy to walk in the bright moonlight. The road is well lighted. You do not bump into things. You can see well in the moonlight.



The moon looks like this through a telescope



You may say to yourself, "How bright the moon is tonight! It is as bright as day." Yet that is never true. On the very brightest moonlight night it is dark compared to daylight.

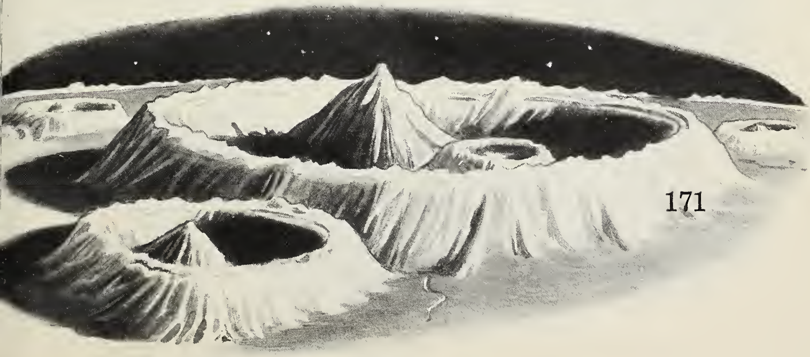
Just try reading a book on a bright moonlight night. Can you read it? Yet on even the darkest days it is light enough for you to read a book. So you know that moonlight is not nearly so bright as daylight.

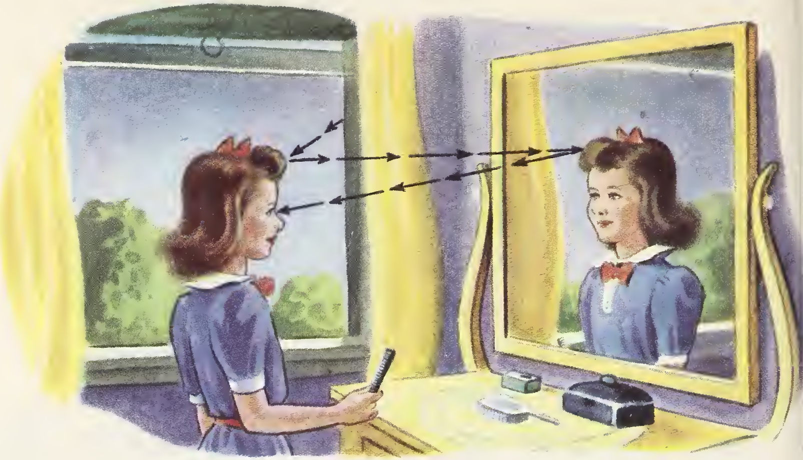
There is a reason why moonlight is not as light as daylight. The moon is not hot like the sun. The moon is gray and cold. It is not made of hot gases like the sun. It is solid like the earth.

Scientists think that the moon may once have been part of the earth. It has rocks such as the earth has. There are mountains on the moon, too. But there is no air on the moon. And there is no water on the moon, either. So we know there could be no plants or people or animals living on our moon.

The sun gives us light because the gases are so hot that they glow. The moon cannot give us light in that way. How then does the moon give us light?

The moon reflects the sunlight. It is somewhat like your mirror. When you look into the mirror in your room you see yourself. You can see other objects in the mirror, too. Sometimes you can see your bed or your chair or your desk.





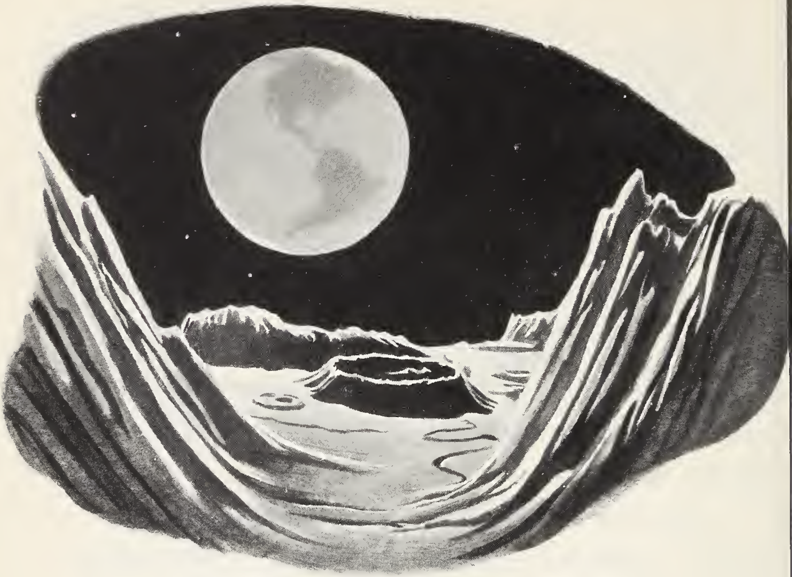
We say the mirror reflects light. The mirror is very smooth. Rays of light strike the smooth mirror. These rays are sent back to your eyes. You see the reflection of yourself or your chair or your bed in the mirror.

The moon is something like your mirror. The sun's rays shine upon the moon. The moon reflects the sunlight to the earth. We call it moonlight, but perhaps we should call it sunlight instead. For it is really reflected sunlight that we see when we see the moonlight.

# Days and Nights on the Moon

You know why we have day and night upon the earth. It is because the earth turns, or rotates, once every twenty-four hours. For about twelve hours our half of the earth faces the sun. Then we have day. For about twelve hours our half of the earth does not face the sun. Then we have night.

Some of the other planets rotate, too. This rotation causes day and night for those planets. Their day and night is not the same length as day and night on the earth.

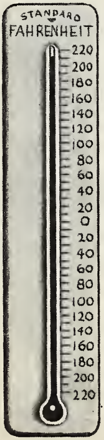


Although the moon is not a planet it rotates as planets do. The moon has days and nights just as we do here on earth. But the days on the moon are very long. The nights on the moon are long, too.

There is only one day and night on the moon while we are having about thirty days and nights. There are only twelve long moon days and twelve long moon nights in a year.

The moon turns around, or rotates, once in about thirty days. For fifteen days a place on the moon faces toward the sun. That is its long moon day. Then for the next fifteen days this place on the moon does not face the sun. That is its long moon night.

You know how hot a summer day gets here on earth. Think how very hot the long moon day must become. Think how very cold it must be during the long moon night. We should need a big pile of warm woolen blankets to keep us from freezing during the long moon night. We should welcome a swimming pool near by to cool off in during the long moon day.



## Can You Find Out?

1. The earth is one of the nine planets that revolve about the sun. Can you find out the names and some interesting facts about the other eight planets? Can you find out how each planet was named?

2. Some of the other planets have moons, too. Look in your science books to find out which other planets besides the earth have moons?

3. The moon does not always look the same. Where can you find out why the moon seems to change its shape? Look in the science books you have in your school library.

4. Look at the picture on page 159. It shows several planets. Can you name the planet that is nearest the sun and the one that is farthest away from the sun?

5. The sun is very, very hot. Can you find out how hot the sun really is?

6. Pluto was the last of the nine planets to be discovered. Can you find out when Pluto was discovered and by whom?

7. The moon has something to do with the tides. Read to find out what causes the tides.

8. Each planet travels around the sun. The length of time it takes for a planet to travel around the sun is called a year for that planet. The year on our earth is 365¼ days. Can you find out how long a year is on Mars, Venus, Jupiter, Mercury, and Pluto?

9. A year on Mars is about twice as long as a year on our earth. Can you find out how old you would be if you lived on Mars instead of on the earth?

10. The sun is 93,000,000 miles away from the earth. The moon is 240,000 miles away. Can you find out how much farther away from the earth the sun is than the moon?

# The Sounds We Hear

# Listening to Sounds

If you live in the city, you are used to hearing many sounds. You hear the rumble of trains and trolley cars. You hear the sound of horses' hoofs on the pavement. Your roller skates make a roaring sound as you skate along the street. The delivery cart clatters past. The loud voices of newsboys reach your ears.

The sounds you hear in the country are quite different. Many of them are softer noises. Leaves and twigs crack under your feet as you walk in the woods. The brook sings to you as you stoop to pick up a pretty rock. Rain patters gently upon the roof. Frogs croak in the pond far away, and the owl hoots in the treetops.

# What Is Sound?

What is sound? How does it travel? How does the sound of thunder reach you from so far away? Let's experiment with sound and find out for ourselves.

Hold a good strong knife at the edge of the table. Hold it tightly with one hand and press down on the end of the blade. Then let go. Feel the air move in front of it. Watch the blade move up and down quickly. We call this rapid movement vibration. We say the knife blade vibrates. As it vibrates, it starts a humming sound. Do it again. Does it make the same humming sound?

Now try another knife that has a shorter blade. It hums, too. But it has a different humming sound. Its hum is higher than the other one was.

In each case the moving knife blade sets the air around it vibrating. The air waves move out in all directions. If you could see the air waves vibrating, they would look something like the little waves you see in the water after you toss a stone into it. The air waves reach your ear, and you hear the sound.

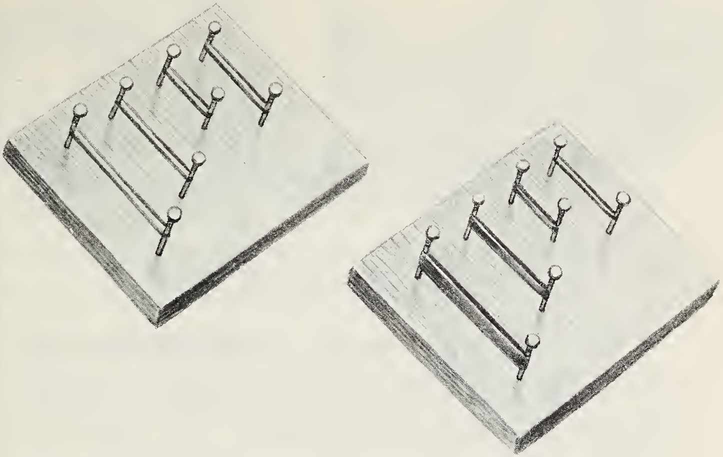
Sound is really made when something vibrates. You hear a hum when the knife blade vibrates. You hear a bird when it sings because the bird's throat vibrates.

You can feel your throat vibrate when you talk. Put your hand to your throat. Do not talk. Can you feel any vibrations?

Now talk to someone. Can you feel the vibrations in your throat? The vocal cords in your throat vibrate as you talk. They make the air near them vibrate, too. These air waves travel to your ear, and you hear the sounds your throat makes.

Hold a rubber band in your two hands. Stretch it out until it is tight. Now have someone pluck on the rubber band with his fingers. You can hear a hum. You can see the band vibrate.

Now stretch the band a little tighter. Pluck it again. What happens to the hum now? Is it a higher or a lower sound?



You can make a sounding board. Do it in this way. Pound nails part way into the board just as you see them in the picture. Use four rubber bands that are the same size. Stretch a rubber band between each pair of nails. Now pluck the bands one by one. Which sound is lower? Which sound is higher?

Now try the same experiment again. This time use rubber bands of different sizes. What happens to the humming sounds now? The sounds were started by the vibrating rubber bands.

# Making a Telephone

Did you ever make a telephone with tin cans? You can talk through it to your friend who lives next door.

Choose two tin cans of the same size. Punch a tiny hole in the bottom of each can. Wax a long strong piece of string and run it from the hole in one can to the hole in the other can. Tie a knot on each end of the string so it won't pull through the holes. Stretch it very tightly.

Now hold one can to your mouth. Have your friend hold the other can to his ear. Talk to him. Did he hear what you said to him?

Let your friend talk to you. Can you hear what he says to you? Explain why the tin-can telephone works so well.

# Sound Travels through Air

You already know that sound can travel through the air. It can travel many miles through the air. You can hear thunder for many miles. Loud sounds travel farther than soft sounds.

Hold a watch close to your ear. Can you hear it? Keep moving the watch a little farther away from your ear. Can you hear it now? You can't hold a watch far away and still hear it because the sound the watch makes is a soft sound.

We say that air conducts sound. "Conduct" is not a new word to us. We know that copper wire conducts electricity. The electricity travels along copper wire. So when we say air conducts sound we mean sound can travel through air.

# Sound Travels through Metal

Metal conducts sound. It is a better conductor of sound than air is. You can prove this with any of these experiments.

Put your ear close to a wire fence. Have your friend walk several feet away. Now ask him to tap very lightly on the fence. Can you hear the tapping?

Have him tap again, but this time do not put your ear to the fence. You cannot hear the tapping sound as clearly now.

Keep moving farther away from each other. You will reach a place where you can hear the tapping only when your ear is close to the fence. Then you will know that metal conducts sound better than air.

You can do this experiment to prove the same thing. Find two radiators in two rooms in your house. Stand with your ear close to one radiator. Have your friend tap the other radiator with a stick. Can you hear the tapping? Can you hear it when your ear is not near the radiator?

## Sound Travels through Soil

This story is told of one way that the Indians used to find out where buffaloes were grazing. The Indians couldn't see very far in hilly country. They put their ears to the ground and listened. They could hear the sound of the buffalo herd through the ground. Try to find out whether this story is true.

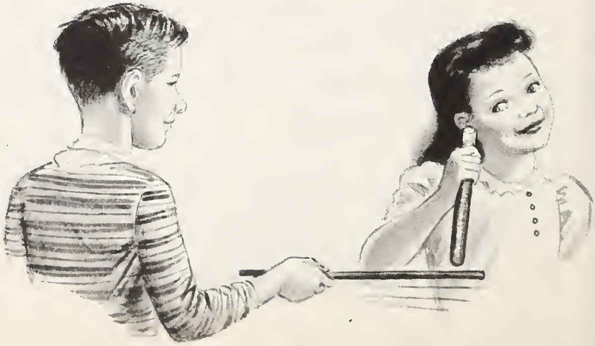
When you go out to play, go around the corner of your schoolhouse. Have the rest of your class stay together in front of the schoolhouse. Have the children stamp upon the ground.

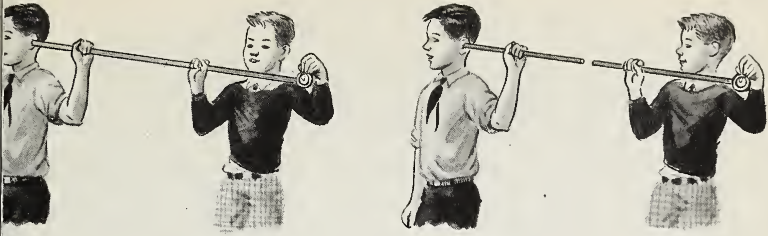
Put your ear close to the ground. Can you hear the sound of the children's stamping feet? Can you hear the sound when you stand up?

There is another way to prove that soil conducts sound. Fill a hollow tube with soil. Pack it in tightly. Leave as few air spaces between bits of soil as you can. Now have someone tap the soil at one end of the tube while you hold your ear to the other end of the tube. Can you hear the tapping?

Loosen the soil so that there are more air spaces in the tube. Repeat the experiment. Can you hear the tapping this time?

Sound travels better through well-packed soil than it does through loose soil. Is this sentence true?





# Sound Travels through Wood

Try this experiment to see whether sound can travel through wood. Find a thin piece of wood about a yard long. Hold one end of the stick to your ear. Have someone hold a watch at the other end of the stick. Can you hear the watch ticking?

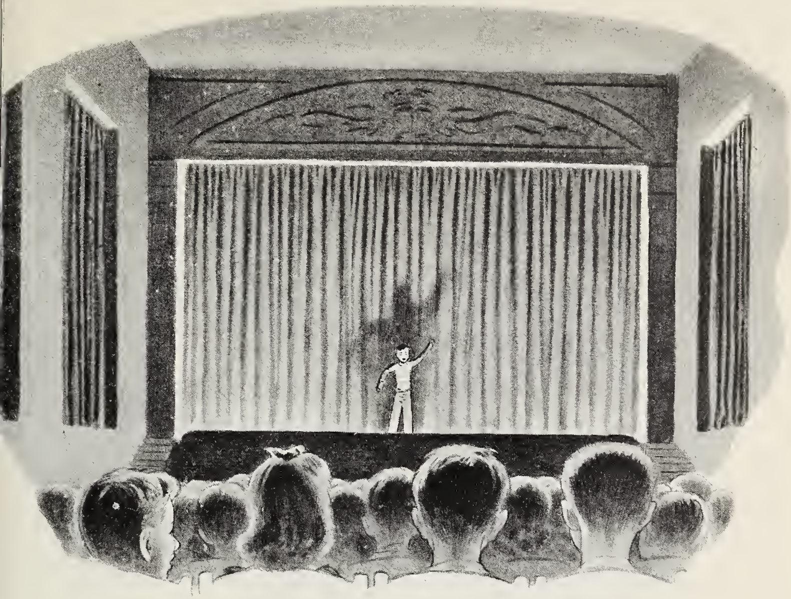
Now saw the piece of wood into two pieces. Hold the two pieces apart as the children in the picture are doing. Hold the watch at the end of the stick that is away from your ear. Is the sound as loud now as it was before you cut the stick in two? What two things did the sound have to travel through? Does sound travel as well through air as through wood?

# What Is an Echo?

Did you ever hear an echo? Sometimes you can hear the echo of your own voice. Do you know what causes the echo?

Toss a rubber ball against the wall of your schoolroom. The ball will bounce back to you. It hits the wall and can't go forward any farther. So it returns to you.

An echo works in somewhat the same way. The sound vibrations travel forward until they are stopped by something. Sometimes the side of a high hill keeps the vibrations from going forward. Sometimes the walls of a high building stop the vibrations. They bounce back at you. You hear your own voice again.



The auditorium of your school may be a place where you can hear echoes. Many large rooms do echo a great deal. Sometimes the echo in the auditorium makes it hard for us to hear well. The curtains at the windows and the curtains on the stage help to make the echo less loud. We say they do not allow the sound to bounce back to you. They really absorb, or stop, the sound.

## Things to Think About and Do

1. You know that sounds are really vibrations. Be ready to tell what it is that vibrates in each of the following:

When you clap your hands?
When a cannon goes off?
When you hit a nail with a hammer?
When you slam the door?
When you play a violin?
When you play a piano?
When you hit a bass drum?

2. Have you seen cheerleaders at a football game? They always talk through a big horn called a megaphone. You can hear the cheerleader better when he talks through a megaphone. Make a megaphone and try it yourself. Roll a piece of paper or cardboard so that it looks like a large ice-cream cone. Speak into the small end of it. How can you explain what happens to the sound of your voice?

3. John and his father rode through a long tunnel in their car. John saw a sign which read, "Do not sound horn in this tunnel." How can you explain why such a sign was put in the tunnel?

4. Mary did an interesting experiment with sound. You may wish to try Mary's experiment.

Find five empty glasses of the same size. Put a little water in the first glass. Put a little more water in the second glass. Keep filling each of the other glasses a little fuller. The fifth glass should have more water in it than any of the others. Now tap each glass gently with a pencil or a drumstick. Which glass has the highest sound? Which has the lowest sound?

# Gardens

# Making a Garden

Did you have a vegetable garden of your own this year? Many families have fun working together in their gardens. They work hard to get the ground ready to plant. They take good care of their vegetables.

Many people now know how good an ear of corn tastes when it is cooked and eaten soon after it is picked. And the tomatoes that you pick before lunch seem to taste much better than those you buy.

It is fun to garden. But it is hard work too. If you are going to have a vegetable garden, there are many things for you to learn. Do not choose too large a plot. A small garden can grow a great deal of food.

# Choosing a Garden Plot

Every garden needs sunshine. You should choose a spot for your garden that gets five hours or more of sunshine each day. If there is less sunshine, the garden will not grow well.

Every garden needs water. But you must be careful to choose a spot where the water does not stand in puddles after a rain. Watch the spot you are thinking of choosing. The water should not stand on your garden longer than an hour after a heavy rain.

Every garden plot must have good soil. You need some sand in your garden plot. You also need some clay in your garden plot. Soil that is made of sand and clay mixed together is called loam. Your garden needs loam.

A good garden plot needs plenty of humus. Humus is the material which is formed when the leaves and stems of plants decay. Most gardeners add humus to their garden soil. Some people get humus from the woods. The growing plants get much of their food from humus.

You can test your soil to see what is in it. Dig up a shovelful of soil. Mix it well. Put some of it into a glass jar. Fill the rest of the jar with water. Shake well and set it aside overnight.

The next morning you will see layers of soil in the jar. The coarse part, called gravel, will be at the bottom. If this layer is thick, you will know there is too much gravel in your soil. Plants do not grow well in gravel. There is not enough food for the plant in this kind of soil.

There will be a layer of sand or clay or both on top of the gravel. This layer should be much thicker than the bottom layer. This layer has plant food in it.

The top layer will be silt. Silt is very fine soil. You have seen it carried along in streams after a rainstorm. Silt is very good soil for gardens. You should have quite a thick layer of silt in the jar.

You will see some humus in this top layer, too. Some of it may be floating in the water. If there is none to be seen, you will know that you need to add humus to your garden.

## Getting Ready to Plant

Have you chosen the plot for your garden? You must next get it ready for planting. Your plot may be plowed or spaded as soon as the frost is out of the ground. Be sure to have the plot plowed about eight to ten inches deep.

Early plowing or spading helps to destroy the harmful insects that live in the ground all winter. These insects will eat your garden crops later on. So it is well to destroy them by early plowing.

Do not work the plowed ground for three or four days. Let the damp soil dry out first. Then you will need to break up the coarse pieces of soil. Use a garden spade to do this work. Shake the soil loose from the bunches of grass. Fork the bunches of grass down deep under the soil. It makes good fertilizer.

Now is the time to pick up the stones if there are any in the plot. Stones get in the way of the plants as the plants grow. They will dull your hoe when you start weeding your garden. So pick them up and carry them to the edge of your garden.

Now the soil is ready to rake. Rake it until all the coarse pieces of soil are broken up. The rake levels the soil, too.

As you know, you can improve your soil. We call the material used to improve the soil a fertilizer. A fertilizer is really a kind of plant food. Many gardeners spread cow manure or chicken manure over their plots before they plow. The manure then is plowed under. It furnishes the kind of plant food that we call organic matter.

Plants need mineral foods as well as organic matter. You can buy fertilizer that has minerals in it. These fertilizers may be spread over the garden after it has been spaded. Spread the fertilizer about as thick as dew on the grass. Then rake it into the soil.

Do not plant any of your seeds for several days after spreading this mineral fertilizer. It may be strong enough to kill the roots of young plants. Use from three to five pounds of fertilizer for each one hundred square feet of ground.

Humus is one of the best fertilizers. It has both organic matter and minerals in it.

Some soils are sour. They have too much acid in them. These soils need to have lime on them before they are planted.

You can find out whether your soil needs lime or not. Buy some blue litmus paper at any drugstore. Put the litmus paper down into a cup of wet soil taken from your garden. If the blue paper turns red, you know your garden soil is acid. It needs to be sweetened. Lime sweetens the soil.

Lime may be put on any time before planting. Use about five to seven pounds for one hundred square feet. Be sure to rake the lime in so that it will not blow away.

# Deciding What to Plant

Of course you will be anxious to plant your seeds. What are you going to plant? You will want to plant the kinds of vegetables your family likes. And you will also want to plant the kinds of vegetables that are good for you.

Some vegetables are much better for you than others. They contain more vitamins and minerals than other vegetables. Vitamins are substances your body needs. Vitamins are known by names and by letters.

You should be sure to plant some green leafy vegetables. Swiss chard, spinach, or kale will have vitamin A in them. You should have one of these green, leafy vegetables ready to harvest from early spring until frost. Swiss chard will give you food all summer if you keep cutting it. It is a delicious and healthful green vegetable. It is easy to grow, too.

You should have some yellow vegetables in your garden. Carrots, rutabaga, or summer squash also will supply you with vitamin A.

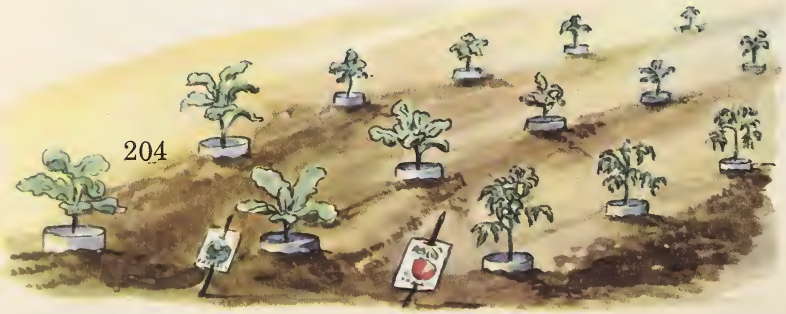
Don't forget to plant tomatoes. They have many vitamins in them. You might wish to raise enough so that your mother could can some for use next winter.

You will probably buy your tomato plants. When all danger of frost has passed, you will transplant them to your garden. Be careful not to disturb the roots. Take a ball of soil around the roots. If you put a paper collar around your plants you will protect them from cutworms. A paper cup makes a good collar. Cut out the bottom of the cup.

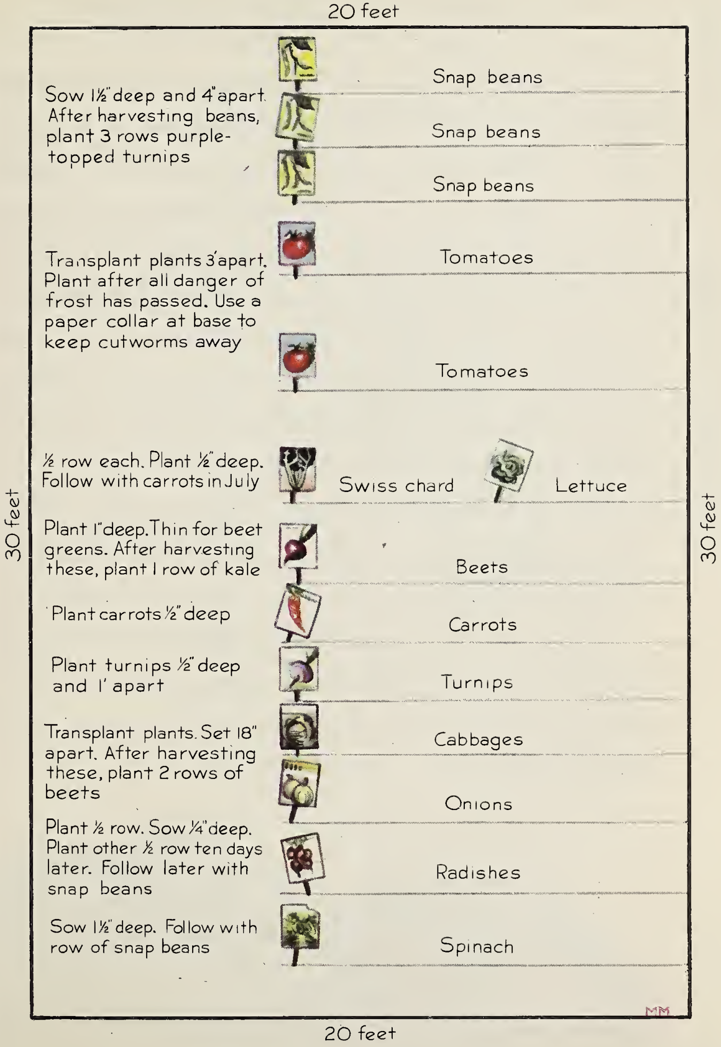
Snap beans, beets, onions, radishes, lettuce, and turnips may be grown in a small garden. Sweet potatoes, winter squash, pumpkins, and corn take so much space that only large garden plots have room for them.

You will want some cabbage in your garden because it is such a good way to get vitamin C. When oranges and tomatoes cost too much, you can get your vitamin C by eating cabbage. It is a vegetable all of us should learn to like. Cabbage plants are usually transplanted in much the same way that tomato plants are. Protect your cabbage plants with paper collars, too.

The chart on the next page shows you many things you will need to know about planting. Use it when planting your garden. It will tell you how far apart rows should be planted. It will also help you to know how deep to plant the seeds. If you follow a garden plan for planting, you will have some vegetable ready to eat each day of the summer.



# Plan for garden 30 feet by 20 feet



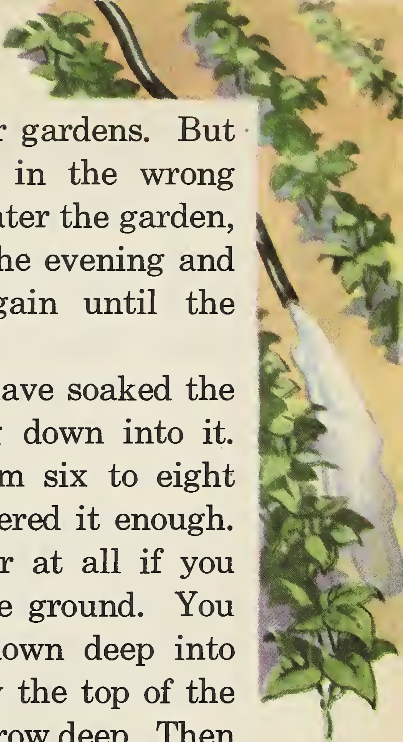
| | |
|---|---|
| Sow 1½" deep and 4" apart. After harvesting beans, plant 3 rows purple-topped turnips | Snap beans<br>Snap beans<br>Snap beans |
| Transplant plants 3' apart. Plant after all danger of frost has passed. Use a paper collar at base to keep cutworms away | Tomatoes<br>Tomatoes |
| ½ row each. Plant ½" deep. Follow with carrots in July | Swiss chard<br>Lettuce |
| Plant 1" deep. Thin for beet greens. After harvesting these, plant 1 row of kale | Beets |
| Plant carrots ½" deep | Carrots |
| Plant turnips ½" deep and 1' apart | Turnips |
| Transplant plants. Set 18" apart. After harvesting these, plant 2 rows of beets | Cabbages<br>Onions |
| Plant ½ row. Sow ¼" deep. Plant other ½ row ten days later. Follow later with snap beans | Radishes |
| Sow 1½" deep. Follow with row of snap beans | Spinach |

# Caring for Your Garden

A weed is just a plant in the wrong place. You don't want weeds in your garden. They use food that your plants need. It is well to hoe or pull out the weeds when they are tiny. After each rain, hoe out the weeds in your garden. Do not hoe deeply. Cut the roots of the weeds just beneath the surface of the ground. Keep your hoe clean and sharp. Then it will be easier to cut the weeds.

Do not hoe too near the plants. You may injure the roots if you hoe the soil close to them.

Many beetles and other insects eat vegetables. You will need to spray your beans and cabbage with a spray which will kill the beetles and other insects.

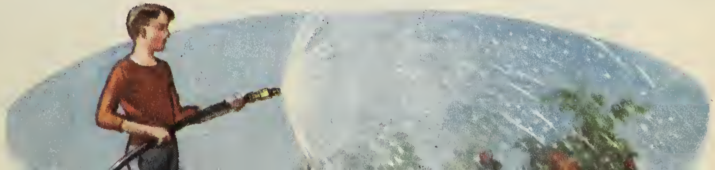


Many people water their gardens. But many people water them in the wrong way. If you are going to water the garden, give it a good soaking in the evening and then do not water it again until the ground dries out.

You can tell when you have soaked the ground enough by digging down into it. If you have soaked it from six to eight inches deep, you have watered it enough.

It is better not to water at all if you only wet the surface of the ground. You want the roots to grow down deep into the soil. If you water only the top of the surface, the roots will not grow deep. Then the hot sun will burn them.

Use a fine spray on your garden hose. You may lay the hose between the rows without the nozzle on it. Let the water run slowly between the rows. Never water the garden with a strong force. Keep moving the hose around between the rows of vegetables.

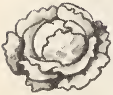


# Harvesting the Vegetables

My, what fun it will be to pull your first bunch of radishes or enough lettuce for a salad! How good these first vegetables taste! Before you know it, the young onions, called scallions, will be ready to eat. And then the beans and Swiss chard and beet greens will be ready.

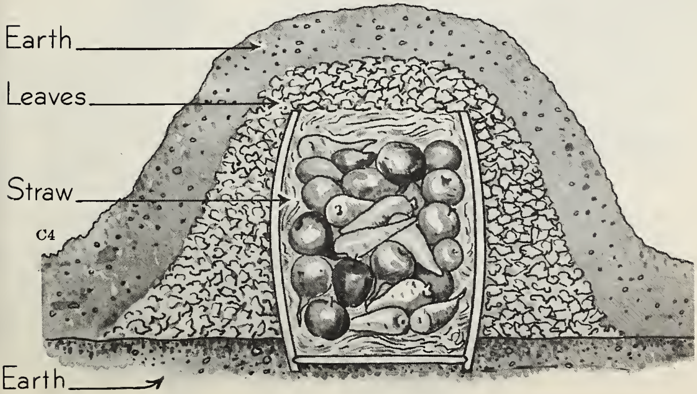
You should look over your vegetables each day and harvest the crop that is ripe. Pick only what you will use that day. Some vegetables lose their vitamins quickly. You want to get the full value from your vegetables. Green vegetables wilt soon after they are cut. Cut them just as you want to use them.

Sometimes there will be more vegetables than you need. Have your mother can them for winter use. Do not waste them. They will taste good for supper on a cold winter evening. You will be glad to have them.



Many vegetables can be stored. Carrots, onions, beets, cabbage, and rutabaga will keep a long time. Store them in a dry cold place. Do not let them freeze. Some people store vegetables in the attic. Some people store them in barrels sunk underground or in cellars. Any place where the vegetables can be kept cool and dry will do.

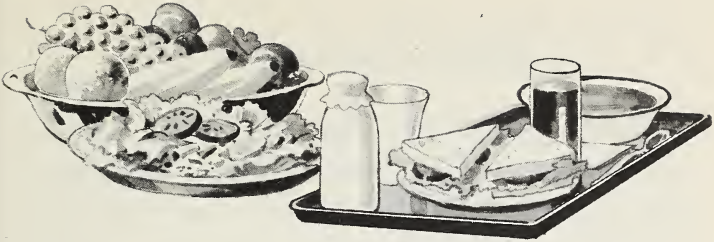
You may want to keep a garden record. It would be fun to record the date you plowed or spaded your garden. Then you might want to record the dates you planted each vegetable. Of course you will want to record which vegetables were ready first. If you sell any vegetables you could record that too.



# A School Garden

Some children had a fine school garden. They kept a record of the many things they did in their garden. They worked hard in their garden. Before school closed they had sold many vegetables.

The garden needed to be cared for over the summer. The children and their mothers and their teachers worked in the garden each week. There was a group for each week during vacation. Over a hundred children worked during the summer.



The groups weeded the garden. They planted seeds for fall harvest. They harvested and sold the vegetables at the garden-gate stand. During the summer the children sold one hundred dollars' worth of vegetables from the school garden.

When school started again in the fall, there were many vegetables still to be harvested. The cooks in the school cafeteria bought fresh tomatoes each day. They used them in salads and soups and sandwiches. They bought Swiss chard and carrots and beets and cabbage. The children enjoyed eating food they had raised.

Many classes made tomato juice. They drank the tomato juice in the middle of the morning. It tasted very good.

# What Vitamins Do

These children learned many things about foods. They learned that vegetables have a great many vitamins and minerals in them. Vitamins help us grow. They keep us strong and healthy.

These children made some charts. They wanted others to know what vitamins do for our bodies. Here are some of their charts.

VITAMIN A

Helps me grow
Makes me healthy
Helps me see well
Helps me avoid infection
Helps me have healthy teeth
Keeps my skin healthy

WHAT FOODS ARE RICH IN VITAMIN A

Green leafy vegetables
Yellow vegetables
Butter
Liver and kidney
Milk, cheese, cream

VITAMIN $B_1$

Helps me grow
Helps keep me healthy
Gives me a good appetite
Helps me digest my food
Helps me have steady nerves

WHAT FOODS ARE RICH IN VITAMIN $B_1$

Lean pork, liver, heart, kidney
Whole-grain cereals
Dried peas and beans
Nuts
Milk
Yeast
Egg yolk
Green leafy vegetables
Tomatoes
Fruits

### VITAMIN $B_2$

Helps me grow
Helps keep me strong
Helps me build strong body cells
Helps me have steady nerves

### WHAT FOODS ARE RICH IN VITAMIN $B_2$

Lean meat
Liver and kidney
Milk, buttermilk
Egg
Tomatoes, apricots
Green vegetables
Yeast
Salmon and haddock
Whole-grain cereals

### VITAMIN C

Helps me grow
Helps keep me healthy
Keeps my gums and teeth healthy
Keeps my blood vessels strong and healthy

### WHAT FOODS ARE RICH IN VITAMIN C

Tomatoes
Raw cabbage, peppers, turnips, spinach
Oranges and lemons
Cantaloupe
Strawberries
Milk
Apples

### VITAMIN D

Helps me grow
Helps make me strong
Helps me build strong teeth and bones
Helps me grow strong straight leg bones

### SOURCES OF VITAMIN D

Sunlight
Special sun lamps
Cod-liver oil, halibut-liver oil, salmon
Egg yolk
Irradiated milk
Butter

The children hung their charts on the bulletin board of the school cafeteria. Here everyone could see them easily. They found that the charts helped them choose a good healthful lunch.

# Nature's Gardens

Have you ever wondered why the plants which grow around your schoolhouse and your home are there?

Have you ever wondered why other plants grow in the fields and forests around your home?

There are very good reasons why some plants grow in one place and not in other places. As you know, plants do not just happen to grow in a certain place. Some plants can grow in warm places and not in cold places. Other plants can grow in dry places and not in wet places.

Some plants must have rich soil in which to grow, while others can grow in stony ground. Still other plants grow well in sunny places but not in shady spots.

If you take a walk around your neighborhood, you will find out which plants grow in sunny places and which ones grow in shady places. There may be a swamp near your home. If you will look at the plants in the swamp, you will find that they are quite different from those that grow in the dry places near by.

# A Swamp

A swamp is one of nature's gardens. Along the edge of the swamp, where the ground is quite damp, you will find some tall grasses growing. You may find red-winged blackbirds or some other birds flying around among these tall reeds and grasses. Sometimes you will find small willows and swamp oaks growing among the tall grasses, too.

In the wettest part of the swamp you will find bulrushes and some cattails. Perhaps you go to your swamp to see blue flags or water lilies that grow there in the summer. Other water plants grow in this wet part of the swamp. All the plants you find in the swamp are there because they grow well there.

# A Pond

A pond is something like a swamp. It may have cattails, bulrushes, and shrubs along its shore. Right out in the water, along the shore, you will see other plants. Perhaps you have rowed your boat along the edge of the pond to gather the lovely water lilies which grow there. These plants have long stems, which grow from the bottom of the pond, and large leaves, which float on the top of the water.

You may have gathered water plants from the pond to put into your aquarium at school or at home. These plants give off oxygen to the fish that live in the pond.

Perhaps you fish in the pond near your home. Rock bass, sunfish, and perch may live in your pond. Turtles probably sun themselves on the banks around the edge of the pond. You may scare the frogs as you walk along the banks.

# A Forest

Do you live near a forest? If so, you may want to find out what kinds of plants grow there. Of course you know that trees grow there. Some forests have beech, maple, and elm trees. Some have hickory and oak trees. Some forests have only evergreen trees in them, such as fir, spruce, and pine trees.

The broad branches and leaves of some of these tall trees catch much of the sunlight. Their roots spread out far into the ground and take in foods from the soil. These foods are both minerals and organic matter.

Underneath the tall trees in the forest you will find smaller plants. These are plants which grow well in shady places. They get very little sunlight. You may find ferns with beautiful leaves. You may find small dogwood bushes. You may find wild flowers tucked in among the ferns.

You may find mushrooms and puffballs in your forest. All the plants which grow beneath the big trees in the forest can grow with very little sunlight. That may be one reason why you find them there.

Your forest is the home of some animals. Many birds find the forest a fine place in which to build their nests and raise their babies. Squirrels eat the nuts of the oak, beech, and hickory trees and build their homes in the hollow trunks or among the branches of these trees. There may be other animals in your forest. Find out why they live there.

## A Meadow

You may want to see what kinds of plants grow in the fields and meadows. The plants that grow in the open country get a great deal of sunlight. They are different from the small plants of the forest.

At different times of the year your meadow may be full of yellow daisies and blue cornflowers. Goldenrod may be growing there. Grass and thistles will be found there, too.

As you walk across the meadow, you may frighten a rabbit from its nest in the thick grass. You may find holes in the ground. These holes may be the doors to the homes of chipmunks, gophers, or other meadow animals. The meadow larks, crows, blackbirds, or other seed-eaters will live here where they can get their food.

The plants in the meadow are there because they are able to grow well in the bright sunlight. They can grow in drier places than some of the forest plants can.

## A Desert

Some plants can grow in places where there are many rocks. These plants are the kind that need very little soil and water.

Plants that grow in desert places have thick stems, which hold the little water they do get from the soil. Their roots spread out in many directions. These plants are able to grow where it is hot and dry because their stems hold water and their roots spread out far and wide to get every bit of water they can reach.

Wherever you happen to live — in the cold north or in the warm south, in cold, wet places or in hot, dry places — there are some kinds of plants growing there. These plants are able to grow there because the sunlight, the soil, and the water are right for them. They do not just happen to be there.

## Things to Do

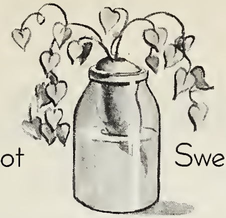
1. You may want to keep a diary of what you do in your garden. Some children put the following things in their diaries:

Date the garden was plowed.
Dates the seeds were planted.
Dates the vegetables were harvested.
Amount of money received for vegetables.
Amount of money spent on garden.
Fun in a garden.
Getting rid of pests.

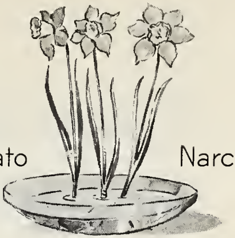
2. You may want to have a garden exhibit for your mothers and fathers to see. Find a place to set it up in your school. Arrange samples of the vegetables on tables. Write the story of how each vegetable grew and what it does for you.

3. Go for walks in your neighborhood. Notice the different kinds of gardens that are growing. See if you can find out why these gardens are growing where they are.

Carrot



Sweet potato



Narcissus

4. If you live in the city, you will have a fine chance to see what a city does to plants. Perhaps you will see plants growing right up through cracks in the sidewalk. You may see a tree that has cracked the rocks near it. You may see grass growing in queer places. You may see beautiful parks that have been carefully planned.

5. If you live in the country, notice the kinds of plants that grow there.

6. It is fun to grow some plants indoors. Grow a bowl of narcissus. Put the bulbs in a bowl. Put little stones around the bulbs. Cover the stones with water. Let the bowl stand in a dark room for about ten days. Then bring the bowl out into the room. Keep the bulbs well watered.

# Plants and Animals Help Us

# Using Plants and Animals

Did you ever stop to think how very important plants and animals are to us? Why not stop right now and make a list of the many ways you use them. Your list might be like this one:

1. I eat plants and animals.
2. I wear clothes made from plants and animals.
3. I have toys and playthings made from plants and animals.
4. I live in a house partly made by plants.
5. I jump a rope that was made from plants.

When you stop to think, you see that you use plants and animals in many ways.

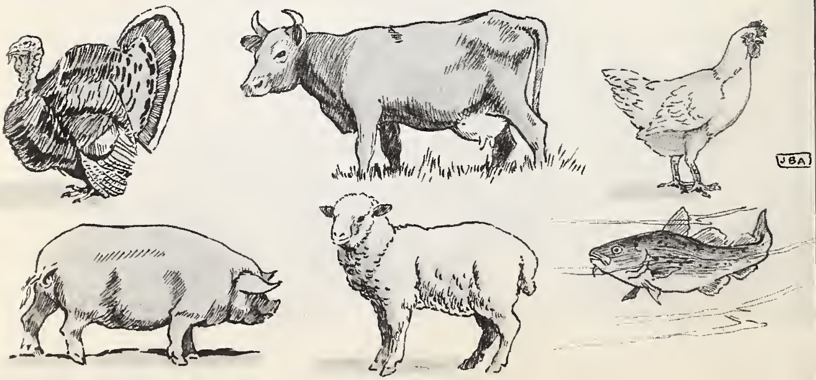
# Food from Plants and Animals

You have heard a great deal about keeping healthy. One way to keep healthy is to eat the right kinds of food. All the foods you eat come from plants or animals.

The next time you go shopping with Mother count the number of plant and animal foods she buys.

First she will stop at the vegetable and fruit counter. Perhaps she will buy oranges for fruit juice, apples or bananas for dessert, sweet potatoes and onions for vegetables, and lettuce, tomatoes, and watercress for salad.

Then she will go to the grocery counter. Here she will buy whole-wheat bread, oatmeal, raisins, tea, strawberry jam, olives, and spices.



At the dairy counter she buys butter, milk, and eggs. And at the meat counter she picks out a chicken and a pound of bacon.

Really everything your mother buys for food is part of a plant or is from an animal that depended upon plants for its food. The chicken eats corn and other grains. The bacon comes from pigs that were fed upon corn. The milk and butter come from cows that eat grass. The eggs are laid by chickens that eat grain.

People who work a great deal with foods are called dietitians. These dietitians are experimenting with foods. They are working all the time to discover ways to get the best food values out of the foods we eat.

Other scientists have been experimenting with foods, too. They have tried to discover what there is in an orange or a carrot or a piece of meat that is good for our bodies. These people who work with foods have told us many things about both plant and animal food that we did not know. New things are being discovered every day. Let us see what some of these discoveries are.

## Vitamins in Foods

Have you ever heard your mother say, "Drink your orange juice; it is good for you"? You know that it is good for you. But do you know why it is good for you?

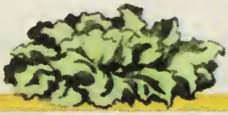
As you already know, foods have vitamins in them. Some foods have more vitamins than other foods. Scientists have found out that these vitamins do certain things for our bodies. One vitamin helps us to grow strong. Another helps us to build good sound teeth and bones.

Scientists have worked a great many years to find out about vitamins. They are finding out new things about vitamins every day.

Some foods you eat are rich in vitamins. The green leafy vegetables give you a good deal of vitamin A. Yellow vegetables have vitamin A in them, too. This vitamin helps you to see well.

[illegible] of green [illegible]
leafy [illegible]
[illegible]

Spinach


Escarole

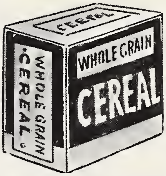
Swiss chard

Green pepper

Carrots

Sweet potatoes

Vitamin $B_1$, or thiamin, is an important vitamin. It gives you a good appetite. It helps you to digest your food well. You will get enough of this vitamin if you eat whole-grain cereals every day.



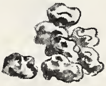
Vitamin $B_2$, or riboflavin, helps you to have steady nerves. It gives you strength and good health. These foods have vitamin $B_2$ in them:

Beets

Red cabbage

Green beans

Spinach


Prunes

Apricots

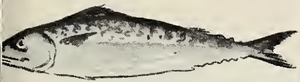
Vitamin C, or ascorbic acid, helps you to build strong teeth and gums. It helps you to grow and keep healthy. These foods have vitamin C in them:

Orange juice

Tomato

Cantaloupe

Cabbage



Fish

Milk
Homogenized or irradiated

Eggs

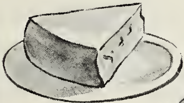
Butter

The best way to get enough vitamin D is to get plenty of sunshine. Very few foods contain much vitamin D. This vitamin helps you to develop strong bones and teeth. It is very important for you to get enough of it. The foods above have some vitamin D in them.

## The Minerals in Foods

Some of the foods we eat have minerals in them. Our bodies need minerals in order to grow. We need calcium to build strong teeth. We need calcium to build strong bones.

lk for calcium

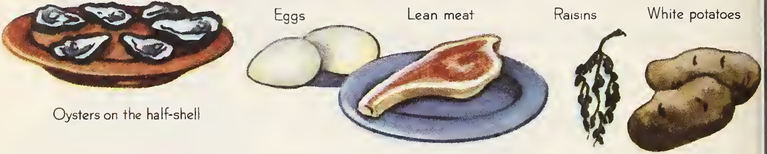


Cheese

Butter

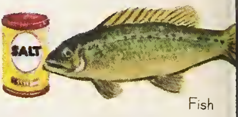
Green leafy vegetables

Iron is another mineral we need. It helps us to build red blood cells. We get iron when we eat these foods:



Phosphorus and iodine, copper and salt are used by the body in order to keep us well. We get them by eating these foods:

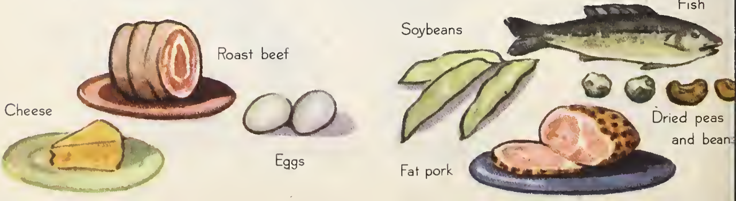
Phosphorus and copper



Salt and iodine

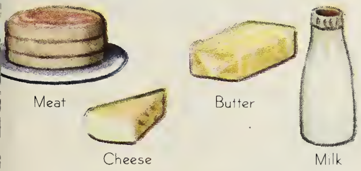
## The Protein in Foods

Protein is another food that we need. We need it for growing new cells for our bodies. We get protein when we eat these foods:



# Getting Energy from Food

All of you use up a great deal of energy every day. You run a lot. You may ride a bicycle. You play games that use a lot of energy. This energy comes from the foods you eat. Some energy comes from the fats you eat. Some energy comes from foods that have starch and sugar in them. These foods give you energy:


Foods that give us fats

Starchy foods

# Choosing Food for the Day

The foods that you see on the chart on page 234 are called the protective foods, because they protect your health. You should choose one food from each group of foods each day.

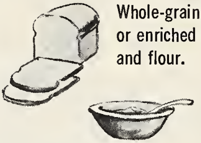
# Protective Diet

*Every Day, Eat This Way*

**MILK AND MILK PRODUCTS**

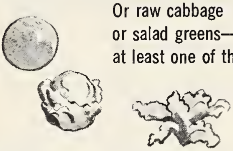
At least a pint for everyone (more for children) or cheese or evaporated or dried milk.

**BREAD AND CEREAL**



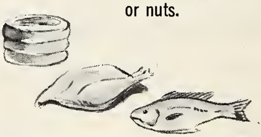
Whole-grain foods or enriched white bread and flour.

**ORANGES, TOMATOES, GRAPEFRUIT**



Or raw cabbage or salad greens—at least one of these.

**MEAT, POULTRY, OR FISH**

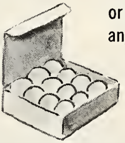


Dried beans, peas, or nuts.

**GREEN OR YELLOW VEGETABLES**

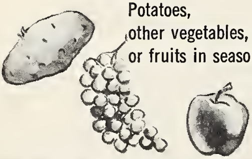
One big helping or more—some raw, some cooked.

**EGGS**



At least three or four a week, cooked any way you choose.

**OTHER VEGETABLES, FRUIT**



Potatoes, other vegetables, or fruits in season.

**BUTTER AND OTHER SPREADS**

Vitamin-rich fats, peanut butter, and other spreads.

*Then Eat Other Foods You Also Like*

# Clothing from Plants and Animals

We use plants and animals for clothing. What a nice warm suit you are wearing! It is made of warm soft wool. Somewhere a sheep gave up its soft coat so you could have a suit.

Your shirt is made of cotton. Somewhere in the warm South the material in your shirt grew upon a cotton plant. The white fluffy cotton had to be picked and made into cloth for your shirt.

Dresses are sometimes made of real silk. The silk may have been spun by silkworms in far-off China. The silkworm ate mulberry leaves and then spun its silken cocoon. The thin silk fibers were wound into thread. Later the thread was woven into silk cloth for dresses.

Yes, and your rubbers ! They may have been made from the milky sap, called latex, of the rubber trees that grow in hot jungles. Native boys gathered the latex. The latex was sent to factories to be made into rubbers and other things.

That brown leather belt of yours is useful. It was made from the hide of a cow. Your leather gloves are made of cowhide also. Your shoes are made from the hide of an animal, too.

Eskimo children wear warm suits made from the fur of polar bears or walrus. Each suit has two skins. One skin is worn with the fur on the inside, next to the body. The other has the fur on the outside. Two layers of fur keep the Eskimo children warm in their cold northern homes.

Indian children used to wear clothing made of deerskin. Their mothers scraped the skin until it was clean. They pounded it until it was soft. Then they sewed it with narrow strips of deerskin.

# Shelter from Plants and Animals

Both plants and animals are used for shelter. Look at your schoolhouse. Has it any wood in it? Are the doors and window frames made of wood? What are the desks and chairs and other furnishings made of?

Many houses are made of wood. Sometimes houses are built of stone or brick and wood. What is your house built of?

Many of the tribes of Indians and Eskimos still build their homes of animal skins. These homes can be moved about easily from place to place. Desert tribes live in skin tents. They move their tents wherever their herds go in search of food.

# Beauty from Plants and Animals

Mother and Father built a new house. It was set back from the road upon a large plot. It was painted white. But there was something wrong with it. It just didn't look right. Can you tell what was missing?

They decided it needed plants around it. First they planted a hedge along the winding path. They set three white birch trees near the corner of the lot. A narrow garden strip was left along each edge of the driveway. They planted tulips there for early spring. In the summer petunias bloomed in these same beds. The lawn was seeded and became a lovely carpet of green.

"What a difference plants make," said Mother. "I like our house now. It looks so homelike and beautiful."

Have you ever watched the birds return to your neighborhood in the springtime? If you have, you know what beautiful bright colors many of them have. The first clear call of the oriole brings you running to see if it is as beautiful an orange and black as it was last spring. The lovely songs of the bluebird, the meadow lark, and the song sparrow make you know that summer cannot be far away. The busy scolding little wren comes again to nest in the birdhouse in the apple tree at the back corner of the garden.

## Other Uses of Plants and Animals

We use plants and animals in many other ways. The paper in this book was made from plants. The paper in your newspaper was also made from plants. Other paper is made from straw and rags.

Have you ever looked at a Navaho Indian blanket? How bright the colors are! The Indians made their own colors, or dyes, from vegetables. They were able to make these clear clean colors with their vegetable dyes.

Some of the medicine your mother gives you is made from plants. Can you think of any medicine that you have ever taken that was made from plants?

You may be surprised at the way some animals help us. The garter snake catches mice and other small animals that eat our plants.

Even the earthworm is our friend. It loosens the soil down deep under the roots of plants. It brings up the soil that has washed down too far for plant roots to reach. It also adds fertilizer to the soil. Wherever earthworms are found in great numbers you may be sure the soil is fertile.

How very useful plants and animals are! We use them for food. We use them for our clothes. We make many of our homes from plant and animal materials. We could not live in the way we do without plants and animals.

## Things to Do

1. Imagine yourself living in a world where you could get only plant foods to eat. Make out menus for breakfast, dinner, and supper.

2. Now suppose you could get only animal foods. Make out menus for breakfast, dinner, and supper.

3. Compare these menus with the chart of protective foods on page 234. Do you have a healthful daily menu? What foods are left out in each day's menu?

4. Make a list of the different raw materials used in making your clothes. Do you have some clothes made from plants? What clothes do you have that are made from animal skins?

5. Some children are thin and need to gain weight. Others are fat and need to lose weight. Make out a healthful daily menu for these children. Let your chart on page 234 help you.

## Some Questions to Answer

1. Why should you eat a green vegetable every day?

2. Why should you eat fruit every day?

3. Why should children drink a quart of milk every day?

4. What do whole-grain foods do for you?

5. What are the animals which we use for food?

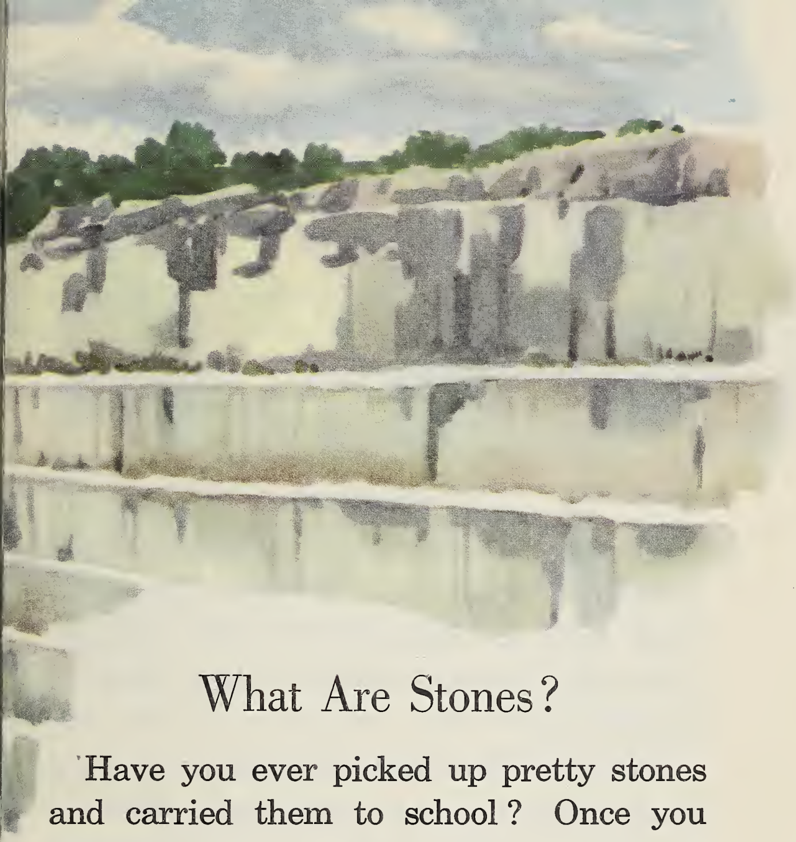
6. What animals does man use to carry his loads?

7. What are some of the plants that are used for making clothing?

8. What animals' skins are used for making clothing?

9. In what ways do plants and animals help one another?

# Rocks and Minerals



# What Are Stones?

Have you ever picked up pretty stones and carried them to school? Once you start to notice stones at all you cannot help wondering about them. This one is green and shiny. That one is clear as glass. Here is one that is sharp on the edges. And this one is as round and as smooth as can be.

You are almost sure to say to your teacher, "What kind of stone is this?" And don't be surprised if your teacher answers, "I don't know what kind of stone it is."

Did you know that a stone is really a piece of rock? Did you know that different rocks have different names? Some scientists spend their whole lifetime in learning about rocks. So don't be surprised if your teacher can't tell you what you want to know about your stones. It will be fun to learn about rocks together.

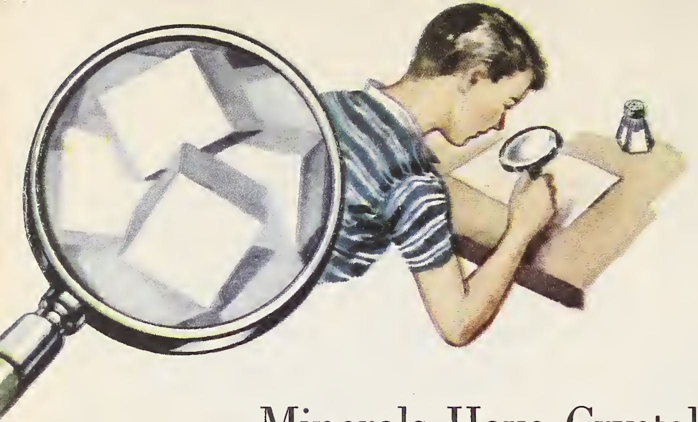
# Rocks Are Made of Minerals

The stones you pick up along the way to school may be all different, or they may be very much alike. Some are dark. Others are pink. Some shine like glass.

That is because rocks are made of different minerals. Each mineral is a different color. A mineral looks the same all the way through. Some rocks are made of many minerals. Some rocks are made of only one mineral.

Crack open one of your stones. Look carefully at the fresh cut surfaces. Can you see little patches that look different from the rest of the rock? These patches in your stone may be different kinds of minerals.

Most rocks that you find will have more than one mineral in them. These minerals are useful to us in many ways. They are often separated from the rest of the rock and made into useful things.



# Minerals Have Crystals

You can experiment with one common mineral. Salt is a mineral. Look at some small pieces of salt. You call them grains of salt. Scientists call them salt crystals.

If you look at salt crystals carefully under a magnifying glass, they will look like those in the picture. The magnifying glass makes the salt crystals look large. You can see them better. Each one is the shape of a square box.

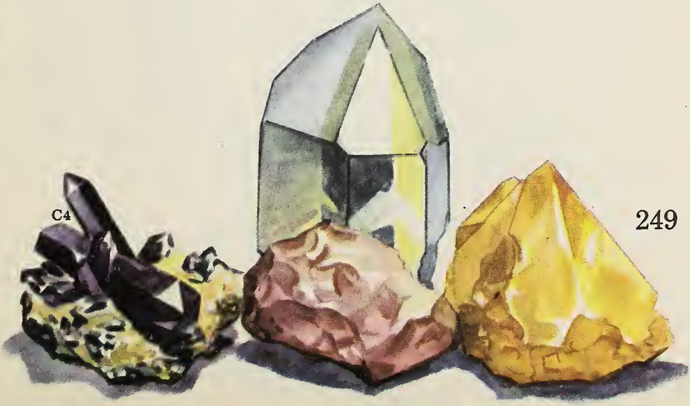
Each salt crystal will be the same shape. Some will be large. Some will be small. Some of them will be broken. But all the whole ones will be the same shape.

Each mineral forms its own kind of crystal. The shapes of the crystals help scientists to tell what kinds of minerals are in rocks.

## Quartz Is a Mineral

Quartz is a very common mineral. It is found in many, many rocks in many, many parts of the earth. Sand is usually quartz that has worn off rocks. The sand you play in was once solid rock. If you have sandy soil near your home, you will usually be able to find some rock with quartz in it near by. Not all of the solid rock may have been worn away into sand.

Quartz crystals usually look like this:



As you see, quartz crystals may be of several different colors. Most of the quartz crystals are clear like glass. Some have a beautiful rose color. Some quartz crystals look like milk and some have a smoky color. Once in a while you will see some purple quartz. It is very beautiful.

Many kinds of quartz crystals are used as jewelry. Have you seen any rings or pins that have crystals like the ones in the pictures? Children often call quartz crystals diamonds. But they are not really diamonds. They only shine like diamonds.

Now try to find quartz crystals in some of the rocks you have brought to school. Look for shiny, glassy-looking patches. Look for rose-colored patches. Look for milky or smoky patches.

Often you may find a stone that is all quartz. It will look the same all the way through. It will be shiny no matter what color it is. These stones are very pretty. Look for one for your rock collection.

If you want to see whether your piece of rock is quartz, do this test. Quartz is a very hard mineral. It is the hardest of our common minerals. If you rub it across a piece of glass, it will make a scratch upon the glass. You can feel the scratch on the glass. Scientists use this test to help them find quartz in rocks.

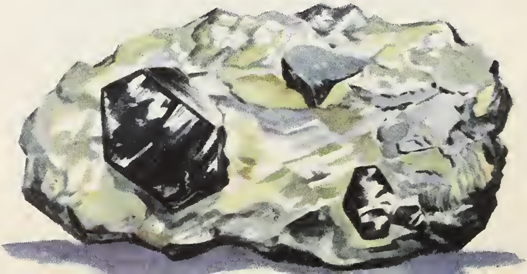
Another way scientists test quartz is to pound it with a hammer. Each mineral breaks in its own way. Some split in layers. Quartz breaks with curved edges. It always chips like this:

# Mica Is a Mineral

You probably have some mica in your rocks at school. It is a very common mineral. Mica shines. It sparkles in the rock. Have you ever seen it sparkle in your sidewalk? It makes you think you are walking upon hundreds of sparkling diamonds.

Scientists have ways to find mica in rocks. You can learn some of these ways. Mica is a soft mineral. You can scratch it with your fingernail. You can peel mica off with your fingernail, too. Mica peels off in layers. Each layer of mica is a crystal.

Sometimes mica crystals are very large. Sometimes mica crystals are very small. But they are always the same shape. Mica crystals are shaped like this:



Mica crystals are sometimes black. Others are very light in color. When you pull off one mica crystal from a rock, you can see through it almost as clearly as you do through glass.

We use mica in a good many ways. It is sometimes used in place of glass in the doors of coal stoves and kerosene stoves. You can look through the mica windows and see how well the fire is burning.

Mica is used in your radio, too. See if you can find out where it is. Do not look for it when the radio is turned on.

# Feldspar Is a Mineral

You are almost sure to find some feldspar in the rocks in your collection. Feldspar is a common mineral. Scientists can tell feldspar in several ways. They know that it looks pearly instead of glassy. It does not shine as quartz does. You cannot see through it easily. They test it by breaking it with a hammer. Feldspar breaks with little flat surfaces like those shown in the picture below.

Feldspar is a hard mineral. But it is not quite so hard as quartz. Feldspar will not make a scratch on glass.

Feldspar may be pink in color. The pink kind is very beautiful. Some feldspar is white, some is gray, and some is green. Sometimes you may think the pink feldspar mineral in your rock is rose quartz. Make a test to find out which one of these two minerals is in your rock.

# Coal Is a Mineral

Coal is a common mineral. It is found in many places in America. You have all seen coal. Perhaps you did not think of it as a mineral. But it is.

Coal was made many, many centuries ago. It was formed from trees and other plants of that long ago time. They grew very large, and when they died they tumbled down to the surface of the earth.

Year after year the dead trees and plants were packed closely together. They were covered with water and soil. This water and soil was very heavy. At last these trees and plants slowly turned into coal.

Coal is one of the few minerals that will burn. It burns because there is carbon in it. The carbon was once part of the trees and other plants from which the coal was formed. It has been locked inside the coal for millions of years.

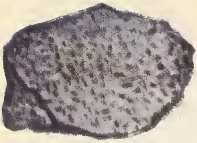
Coal is one of the most useful of all our common minerals. Just think of the many ways we use it every day. It heats many of our homes. It is used to make the power to run machines in factories. It is used to make the power for running many ships and trains. It is a very important mineral.

# How Scientists Know Minerals

Scientists have ways of knowing the minerals they find in rocks. You have been learning about some of these ways. They ask themselves these questions :

What color is the mineral ?
How does it look ?
How hard is it ?
How does it break when pounded ?
What shape are the crystals ?

Don't be discouraged if you cannot tell what all the minerals in your rocks are. Some scientists study years to learn about them. Learning about rocks and minerals can be a hobby. There is so much to learn that this hobby can last a lifetime.

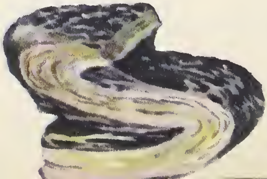


## Granite Is a Rock

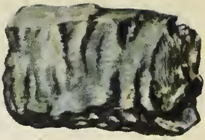
Do you remember that rocks may be made of several minerals? Granite is a common rock. It always has at least three minerals in it. These three minerals are quartz, mica, and feldspar. Sometimes there is a fourth mineral in granite. It is a dark mineral called hornblende. Have you a piece of granite in your rock collection?

## Gneiss Is a Rock

You may have a piece of gneiss in your collection. Gneiss is something like granite. Gneiss has some quartz, some mica, and some feldspar in it. These three minerals are in bands, or streaks, in gneiss. In granite they are all mixed up. Put your piece of granite next to your piece of gneiss, and you will see that both pieces have the same minerals in them.



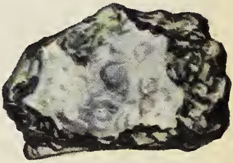
# Mica Schist Is a Rock



You may have a piece of mica schist in your collection. It is not common in all parts of America. But you may live where it is. It sparkles because there is mica in it. It shines because there is quartz in it.

Mica schist is used for stone bridges and beautiful stone buildings.

# Limestone Is a Rock



Did you ever find a rock that had the shell of a tiny sea animal printed in it? Such rocks were made at the bottom of the sea. They were made from many thousands of shells of tiny sea creatures. These shells turned into minerals. That is why you often see the shells printed right in the rocks. We call these prints fossils.

Many rocks that have fossils in them are limestone. Limestone is found in places where water once covered the earth.

This beautiful cave has limestone "icicles" in it. There are many caves like this in the world. Water has dissolved and carried away the minerals that were in this cave. The minerals have formed these beautiful and fairylike limestone "icicles" for you to enjoy.

After many, many years limestone sometimes changes into marble. Great heat and pressure changes the limestone to marble. Both marble and limestone are used as building stone.

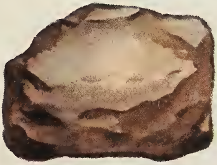
# Sandstone Is a Rock

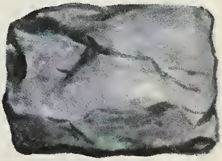
Sandstone is another very common rock. It may be red, blue, brown, or gray in color. It is made from sand. The grains of sand got packed closely together under the sea. Finally they formed sandstone.

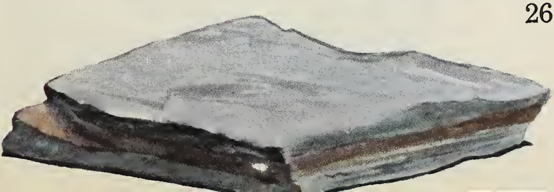
You have seen sandstone buildings. In cities many houses are built of brown and red sandstone.

Sometimes you find a soft red stone that you write with on the sidewalk. This may be sandstone.

You may have a flat stone walk going from your doorstep and across your lawn. You call these stones flagstones. They may be sandstone rocks.





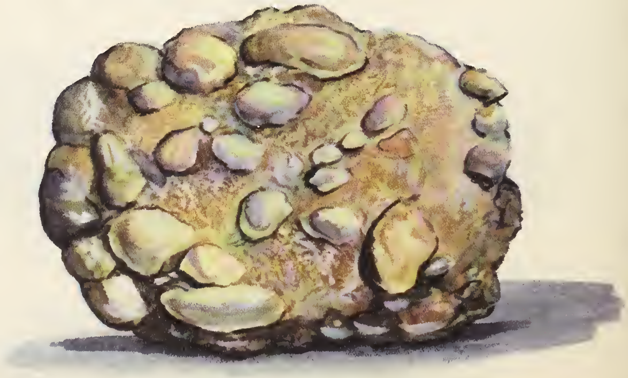


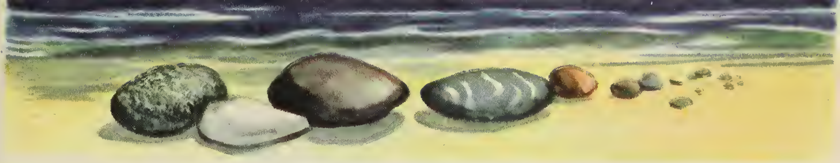
# Conglomerate Is a Rock

Have you a stone in your collection that looks like the one below?

This stone is a conglomerate. It has many little pebbles and sand in it. The pebbles are all held together by something hard like cement.

Take a good look at the pebbles in your conglomerate. Are they rounded on the edges? Most of the pebbles have been rounded by water. Long, long ago the pebbles were cemented together. A conglomerate with rounded pebbles in it is called a pudding stone.



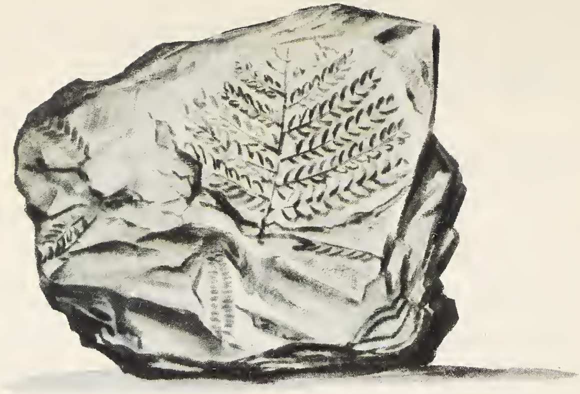


# The Story a Pebble Tells

It is fun to walk along the seashore or stream and pick up pretty pebbles. You can find them all over the beach. How smooth the pebbles feel in your hands. How round the sides are!

The pebbles you pick up can tell you an interesting story of the past. Pebbles like those in the picture may have been made long, long ago in Canada. They are made of sand. We call them quartz pebbles.

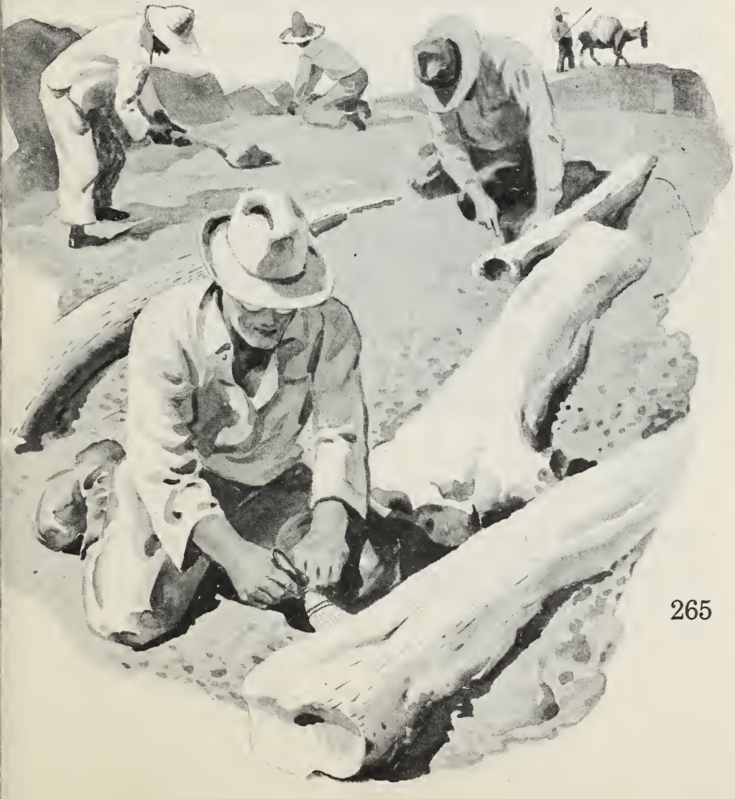
The great ice sheet that came down from the north brought many pieces of quartz along with it. The water and ice of the ice sheet rounded the edges of the rock. We call these rounded rocks pebbles. The pebbles were carried along in streams. They rubbed against each other. At last they were as smooth and round as the ones you have in your collection.



# The Story a Fossil Tells

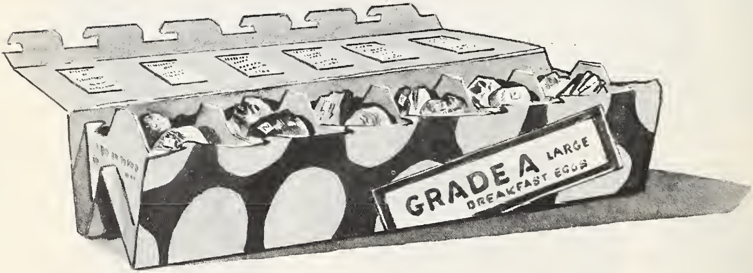
You have already learned about the fossils in limestone. Have you ever studied other stones that have the print of shells or leaves in them? As you know, these prints are called fossils. The leaves of plants or the shells of animals became buried in the clay or sand or mud along rivers, lakes, or oceans. After millions of years the clay and mud and sand changed to rock. The prints of the leaves and shells were made right in the stones as they slowly formed.

Rocks with fossils in them tell an interesting story, too. The fossils tell scientists just what kind of plants and animals were living when these rocks were being formed. We say that scientists read the story of the past in the rocks. And they really do. For these rocks tell them what kinds of plants and animals lived upon this earth long, long ago.



## Things to Do

1. Make a collection of stones that are found near your school. You can use a cigar box to put your stones in. Or you can use an egg box. Put a little cotton in the bottom of the egg box. Put one stone in each section. Number each stone by pasting a piece of adhesive tape on it. Write the number on the tape. Make a list, or key, for your collection. Paste the key on the inside cover of the box.



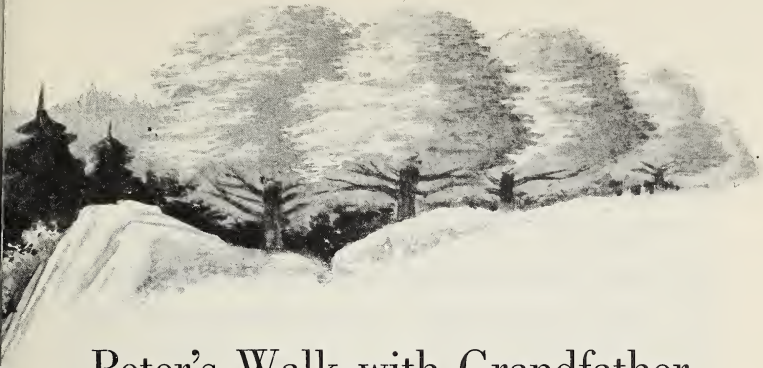
2. Go to a nature museum if there is one near you. Look at the collections of rocks and minerals there.

3. You can buy stone collections from scientific supply companies in many cities. Why don't you save a few pennies and order one of these sample collections? They are very useful for helping you to find out just what your own rocks and minerals are.

4. If you live in a region once covered by the great ice sheet, look carefully at the kinds of rocks that were left by it. Can you see how round many of them are? Can you see any scratches on them? These scratches were made by other rocks rubbing against them.

5. It is fun to play a game with your rock collection. Have each pupil try to name every rock in it. Have him write the name opposite the number of every rock in the collection. When everyone has finished, read the correct names. Let each person check his own list as you read the answers. Do not let anyone see the key to the correct names until the game is over.

# Conservation



# Peter's Walk with Grandfather

Peter lives on a large farm with his father, mother, and grandfather. His grandfather and his great-grandfather had lived on Peter's farm for many years. Peter's grandfather was a very wise farmer. In some ways he was 'way ahead of his time.

Peter's grandfather was not just another farmer. He understood about the land and how important his farm was. He used to talk to Peter about how he loved the land. He often asked, "Where should we be without the land? Where would all our food come from? Where would all our forests grow?"

One day Peter was walking beside his grandfather. They were walking through a freshly plowed field.

"Feel it, Peter," Grandfather said, as he bent over and scooped up a handful of the soft, dark soil. "Feel how soft and rich it is. Why, this ground is better today than it was when I was a boy. Yes, sir, it's a whole lot better."

"How does that happen, Grandfather?" asked Peter. "I thought that land wore out as it was farmed."

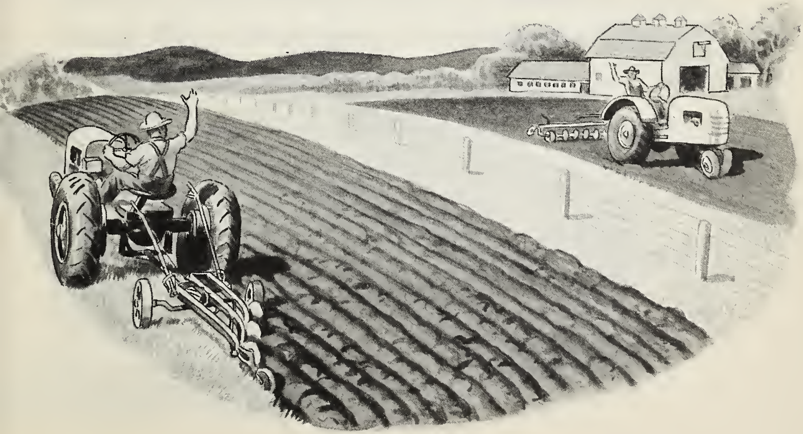
Grandfather just grunted and was silent for a while. Then he said, "Some land does wear out, Peter. But this land hasn't, and I hope it never will. No land needs to wear out."

They walked a little farther, and Grandfather said, "Land is like a car, or a watch, or lots of other things. It needs care — good care! If you keep right on using a car and don't keep it greased and oiled, soon it will not run for you."

Grandfather went on, "Well, land needs care, too. It needs to be cared for just as much as your bicycle does. That's what I've done with my farm. That's what your father is doing, too. He is building up this farm. He is making a better farm year by year. He is farming it right, Peter. And that's what you'll be doing, too. Only you will be a better farmer than either of us."

"Why?" asked Peter.

"Because you have science to help you," replied Grandfather. "Nowadays almost every boy and girl in school has a chance to learn things in science. Every year scientists show us better ways to farm."



When they came to the woods, Peter's grandfather told him about the trees. Some of them were there years before he owned the farm. But all the evergreens on the hillside were planted by him when they were only seedlings. That was over forty years ago, and every spring other young trees were planted. Whenever he cut down the big trees for firewood, he knew he would always have other trees growing up to take their places. In this way he would always have enough trees.

Peter was beginning to understand a little of what his grandfather meant. "I'll plant trees, too," he said, "just as you and father have done. I'll plant a row of maple seedlings right along this road for my grandchildren to enjoy as they grow up. I'll do my part, too."

# America as the White Man Found It

Only four centuries have passed since the first white men came to live in North America. Only four hundred years, and yet what changes have been made!

Those who first came found great forests and spreading plains and winding rivers. America must have seemed very large indeed. So it was then, and so it is today. America in 1492 was a huge storehouse of rich things for the people who came here to use. It was a land so full of riches that man could not think of ever using them all.

These many riches which the early settlers found here we call resources. We often speak of them as natural resources, because they were supplied by nature and were not made by man. Some of the natural resources of our country are soils, animals, plants, minerals, and water.

When the white man came, much of America was covered with rich, fertile soil. Millions of acres of it spread out between the two great oceans. Century after century this rich soil had been forming. Plants had grown upon it, taking rich materials from it. When the plants died, they gave back to the soil more food than they had taken from it. They helped to build more and richer soil. When winds came, the plants held this rich soil to the earth. When heavy rains fell, the plants kept the same rich soil from washing away.

Animals were everywhere. And why not? There was plenty of food for all of them.

The buffaloes found as much grass as they needed on the grasslands. Deer, elk, and moose ate as much as they needed. Birds enjoyed the food and shelter of the forest and grasslands.

Bass, pickerel, and trout were found in fresh-water streams and lakes. Along ocean shores oysters, clams, cod, and mackerel were found in great numbers.

Some of the land was covered with great forests of pine and fir, of maple and oak, of cedar and walnut. There were many millions of acres of trees.

Some of the land was covered with thick green grass. These grasses spread out for miles over the soil. They kept the wind from blowing the soil about and the rain from washing the soil away.

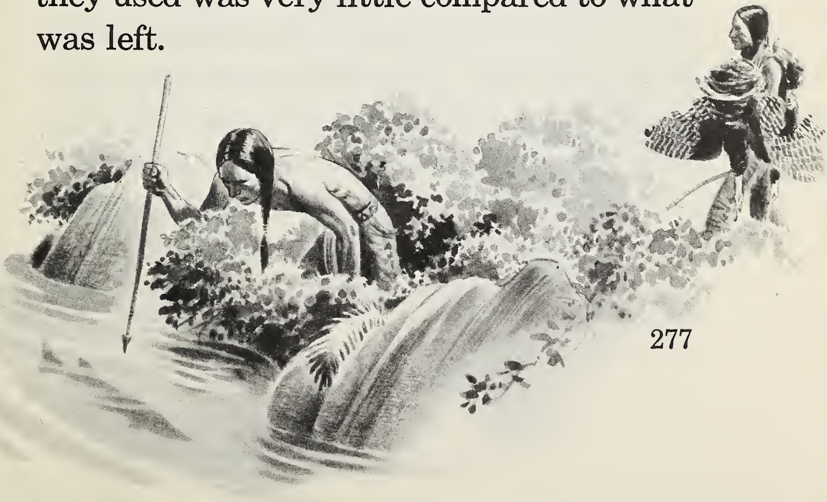
# Indian Ways of Living

Scattered about here and there over this wide rich country lived the Indians. There were less than a million of them in all. How long they had lived in this country we do not know. We know that they had lived here for a good many years.

The Indians had simple ways of living. Some of them had cleared away a few trees here and there and planted corn, squash, or beans. That was about all the farming the Indians did.

They hunted buffaloes, deer, wild turkeys, and ducks for food. Good as their bows and arrows were, there was no danger of their killing too much wild life. They were good fishermen, and took part of their daily food from the clear, cool streams. Their houses were simple things made from the trees they cut down or from the skins of animals which they killed.

America was rich in good soil, fine forests, and wild life. The Indians used some of the great resources which were everywhere about them. They got their living from them. They used what they needed. But there were so few Indians that what they used was very little compared to what was left.



# Timber Is a Crop

Alice sat at her desk in school. She was writing a report about trees. Each time she tried she thought she could do better. Soon she had spoiled several pieces of paper.

"What on earth are you doing?" asked Peter.

"I'm trying to write a report about 'Saving Our Trees,'" replied Alice.

"But," said Peter, "you are wasting them yourself."

"What do you mean?" laughed Alice.

"I can prove it," said Peter.

He told Alice that paper is made from trees. He said that each year many, many trees are cut and made into the paper drinking cups and schoolbooks that children use in school.

"I never thought of that," replied Alice.

"You see," Peter went on, "timber is a crop just as much as corn and beans are.

"The trouble is that most people do not think of trees in that way. They know they have to keep on planting beans and corn each year. But most people never think of planting a tree."

Alice and Peter worked together on the report about trees. They read many things about ways to save our trees. Their report helped others to use materials more carefully.

## Forests and the Ax

The first white men to set foot upon the eastern shores of North America found great forests everywhere. Most of these early settlers had come to America to make homes for themselves and to earn a good living. Many of them were farmers. The tall trees of the great forests stood in the way of their planting crops. Their first job, then, was to clear the land of the trees.

They set to work cutting down the trees and clearing pieces of land for farming. Their log houses were built from the trees they cut. Their food was cooked over the roaring open log fires which they built in the big fireplaces in their log houses.

The pioneers used the tall straight white pine logs for masts for the ships which were to cross and recross the Atlantic.

These ships and others kept bringing more men and women from Europe to America. The new settlers needed to make homes for themselves and to earn a living for their families. Axes went to work again. This time more trees were cut, in order to furnish timber for houses, and also that the land might be cleared for farming.

As time went on, many ships traveled west to America. Travel was less dangerous. Stories spread of a rich new land across the Atlantic. In the new country one could find many ways to make a living.

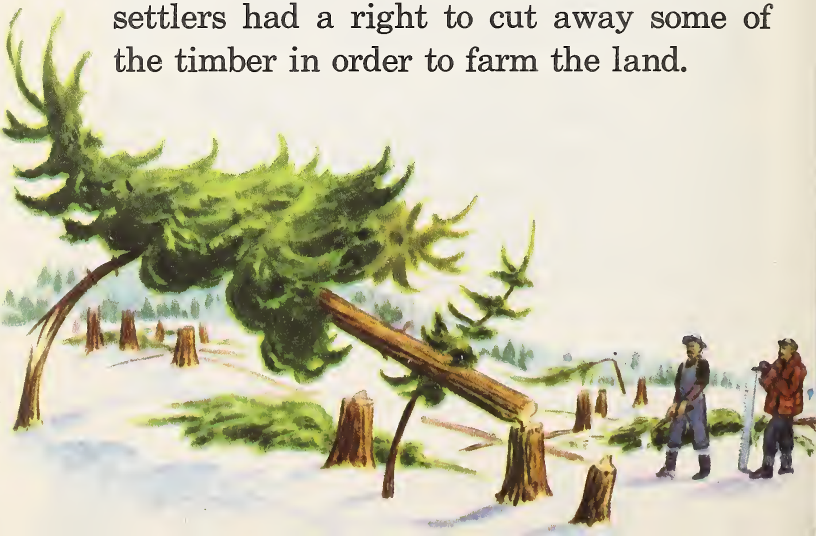
# Across the Continent

The eastern shores became more crowded than some of the settlers liked. To the west spread miles and miles of good land covered with forests. "Let's go where there's more room and more riches," they said.

Some made flatboats and floated their goods and families down the broad streams leading to the west. Others built covered wagons and moved their goods west through mountain passes and along river valleys.

Ahead of them stretched acre after acre of forests. There was more than they needed for their homes, more than they could think man would ever be able to use. There was so much timber that they became careless about how they used it. When they needed land for farming, they cut the timber and made big log bonfires just to get it out of their way.

The white men who first came to America to make homes and to farm did not do a great deal of damage. There were so few men and so many forests. At that time about one half of the land of America was covered with timber. Surely the early settlers had a right to cut away some of the timber in order to farm the land.



# Our Forests

Today there are only about 200 millions of acres of forest fit for lumbering. What, then, has happened to these hundreds of millions of acres of timber? Men found out there was money to be made in lumbering. Lumber companies were formed. These companies bought timberlands from the government at cheap prices. Lumbering really started in America then.

The white pine was the first to be cut. It was so straight and tall and could be sold for a good price to the many shipbuilders. Axes chopped away at the pine in New England. When the best of it was cut, the lumber companies bought forest lands in Michigan, Wisconsin, and Minnesota. Again the axes chopped until the best of the pine was cut down. The lumber companies went on toward the Pacific Ocean, and with saw and ax they cut as they went.

# Forests Save the Soil

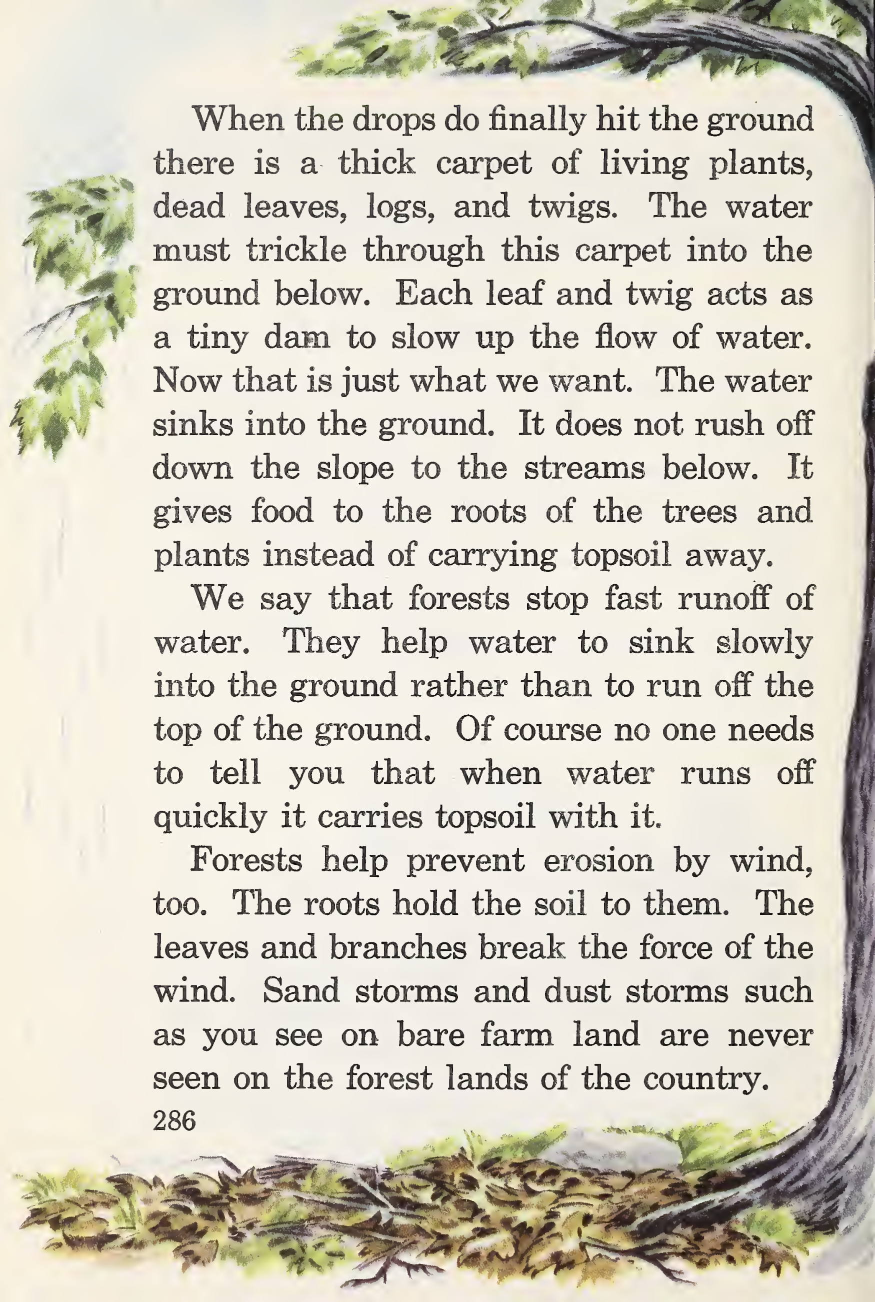
Today we are the losers. Many of our forests are gone. Let us first see what cutting away our forests did to the soil.

Plants grow in the layer of topsoil which covers the earth. It takes about five hundred years to make an inch of topsoil. Four centuries ago the topsoil of some of America's best farming land was many inches deep. Today some of our best farm land has a topsoil cover of less than ten inches. In many places all the topsoil has been carried away.

As you know, there are two great forces which carry topsoil away. One is wind. The other is water. Wind blows topsoil away, and water washes it away. We call this wind erosion and water erosion.

The trees of the forest slow up the work of erosion. Their many roots reach out in all directions and help hold the soil to the earth. The roots of the trees hold the soil so that it cannot easily get away.

When there is a heavy rain, the leaves of the trees help, too. The raindrops hit against the leaves, branches, and trunks of the trees. In this way the raindrops are slowed up so that they strike the ground with less force. Another way of thinking about it is that the trees form a sort of umbrella over the ground and break the force of heavy rains.



When the drops do finally hit the ground there is a thick carpet of living plants, dead leaves, logs, and twigs. The water must trickle through this carpet into the ground below. Each leaf and twig acts as a tiny dam to slow up the flow of water. Now that is just what we want. The water sinks into the ground. It does not rush off down the slope to the streams below. It gives food to the roots of the trees and plants instead of carrying topsoil away.

We say that forests stop fast runoff of water. They help water to sink slowly into the ground rather than to run off the top of the ground. Of course no one needs to tell you that when water runs off quickly it carries topsoil with it.

Forests help prevent erosion by wind, too. The roots hold the soil to them. The leaves and branches break the force of the wind. Sand storms and dust storms such as you see on bare farm land are never seen on the forest lands of the country.

## Saving Our Forests

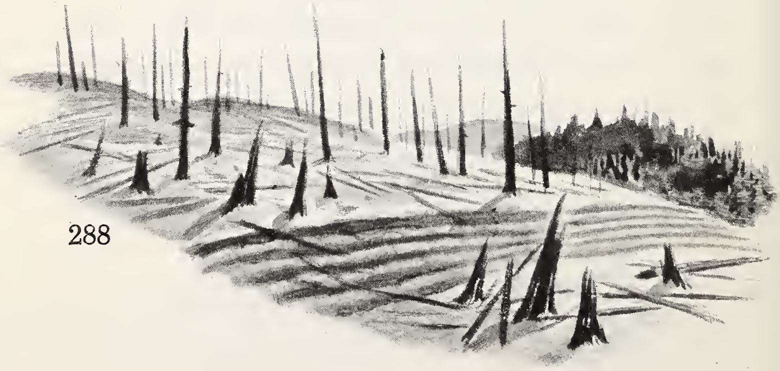
Our forests are important to us in many ways. Forests provide homes and protection for many wild animals. Forests help hold the soil to the earth. They hold back the floods that destroy life. Forests are the farmers' friends. They hold the moisture in his soil. This moisture waters his crops in dry weather.

How then can we save our forests? First let us see whether anything is being done about it. Only within the last fifty years have the people of North America begun working to save the forests. They know now how valuable forests are. They have seen how fast much of the timber of this country has disappeared.

One of the ways the governments of the United States and Canada are helping to save forests is by buying large pieces of forest land, so that it cannot be wasted by bad lumbering.

The Forest Service has charge of the care of these government forests. It has lookout men who watch over the forests. Have you seen these lookout men in their tall fire towers? They watch for signs of forest fires. The lookout men report fires by radio or telephone to the forest rangers, who rush their fire trucks and men to fight the fire.

Sometimes the fire-fighters try to stop the fire by digging wide ditches to keep the ground fire from spreading. Sometimes they start a backfire, which burns toward the real fire. When the two fires meet, they both go out. It is often necessary to cut a wide path of trees, so that the fire cannot spread.



Even though the forest rangers do fine work in fighting fires, more than 50 million dollars' worth of timber is burned each year. Almost all these forest fires are caused by careless people. Campers forget to put out their campfires after a picnic supper. Smokers throw their lighted matches along the roadside. Small fires started by persons who are clearing land sometimes burn too fast and spread to forest lands. Lightning also causes some of our forest fires.

Surely all of us should do everything we can to help save forests from fire. When forest lands are burned over, the ground cover is gone. The topsoil is left free to blow about and wash away.

The Forest Service has other jobs besides fire-fighting. It takes charge of planting trees on cut timberland and on burned forest land. We call this replanting of trees reforestation. It means planting trees where there were trees before.

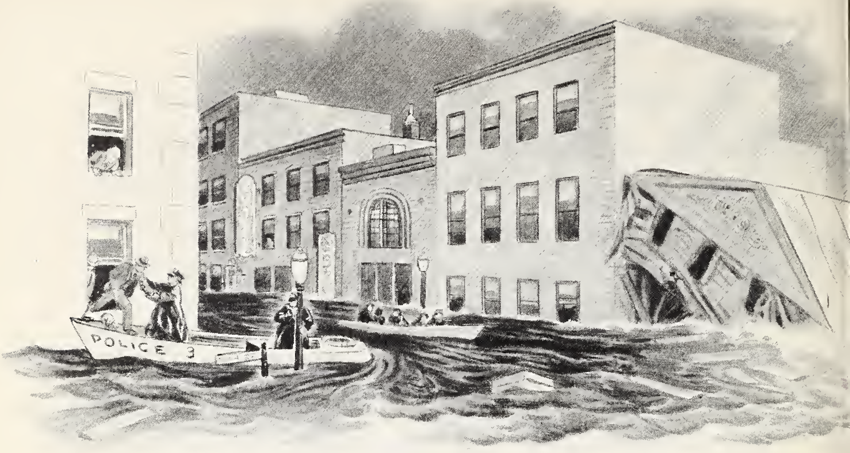
Tiny trees called seedlings are grown. These seedlings are planted on the timber lands. Many thousands of such seedlings are being planted on burnt-over and cut-over timberlands each year. After they are planted, they are well cared for. If the young seedlings were not looked after, many of them would die.

The Forest Service takes charge of cutting the trees which are ready to be cut. Each year men go through the government forests and mark the trees that are to be cut. They leave the young trees, so that they may grow into large trees. They take no more trees out of the forest than they replant each year. In this way lumbering can be done and still the forests are not destroyed.

Another job of the Forest Service is to stop too much grazing of wooded hillsides. Much damage has already been done by turning too many animals out to graze on one piece of land. The foresters rent the forest lands and allow only the right number of sheep or cattle to graze on a given piece of land.

We are glad that the governments of Canada and the United States are at work to save the forests of North America. But we must not leave all the work for them to do. Each of us should help to care for the trees which grow around us. We can plant seedlings and keep them safe while they are growing. We can be sure our campfire is put out before we go home. We can be always careful about fire, so that forest fires never start because of our carelessness.

All these things must be done now and for years to come, so that one of our great natural resources may be saved.



# Rivers and Their Floods

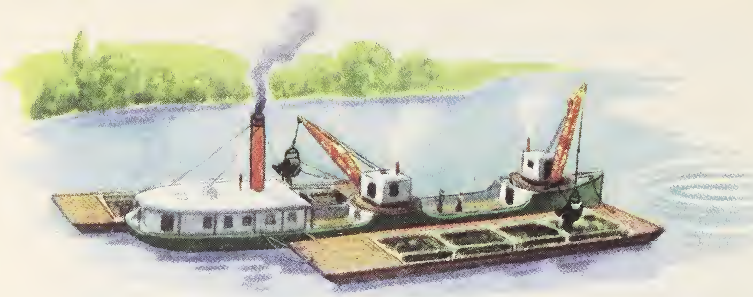
Floods are not new in North America. Many of our large rivers have had floods ever since we have known anything about them. The Ohio and the Mississippi flooded when the Indians lived here.

Rains often fall too fast and hard at one time, and then do not fall at all at other times. Floods happen when the raindrops of the heavy rains can't all get into the stream at one time. The river runs over its banks, and rushes along over cities and fields and valleys to the sea.

Floods do a great deal of damage. They often flow into the streets of large cities and kill people and destroy houses and other buildings. Sometimes large cities are destroyed by floods. When this happens, a great deal of damage is done.

Floods are not good for most farmers. The heavy rains wash the soil from the hillsides and fields down to the valley below. Some of the soil that used to be spread out over the farm land is now piled up along the banks of the stream. Some of it is carried down the stream.

In either case the farmer's land is poorer. He needed the soil that was washed away for his crops. It is now lost to him forever. He cannot bring it back to his farm.



The sand that is carried along down the stream often causes trouble. It piles up farther down the stream. These piles of sand are called sand bars. The rivers then become shallow at these places. Boats that used to carry goods up and down the streams can no longer get past the sand bars. A great deal of money is spent every year to take this sand out of the rivers, so that boats may go up and down.

Floods happen every year. Large floods happen every few years. They happen more often now than they used to. Let us see why.

The ax is to blame for some of the floods. You know that the forests help hold the soil. You know that they slow up the work of wind and water.

You also know that many of our forests have been cut down. The soil was left free to blow about and to wash away. It is little wonder, then, that floods have become worse.

Of course something had to be done about it. For many years the people along the Mississippi River have been building levees and dikes to hold back the water. Levees and dikes are walls built of logs, or stones, or dirt, or cement to keep the water back. Today almost two thousand miles of levees have been built along this one great river.

But these high walls cost money. And even then they do not always keep the Mississippi back. It still floods its banks. Sometimes the walls break because of the force of the water. At other times the water rises above the top of the walls and flows out over the land, killing people and destroying cities and farms. Higher floods call for higher walls.

# Controlling Our Rivers

Levees have helped to keep rivers from flooding. But they are not the only way to keep back the waters of our streams. We can help to prevent floods by planting more trees.

The carpet of plants and leaves and twigs which forms on the floor of the forest breaks the force of the water. More water can sink into the ground in the forest, because it can trickle slowly through the cover of plants and leaves. Not so much water runs off.

Many farmers have helped to keep streams from flooding. They are using better ways of plowing their farms. They plow their fields so that the furrows help hold the water back. Steep hillsides are being planted to grasses. The water on grassy hillsides does not run off so fast as it does on plowed hillsides. The farmers know that they must keep their topsoil on their land.

The more we do to hold back the water of each rainstorm, the more we help to keep floods away. We must help to keep more water on the fields, and let it sink into the ground where it falls.

The water that sinks into the ground is called underground water. This water helps the crops grow in dry weather. But when the water rushes off the land in floods there is not so much underground water for plants to use in the dry season. It has all run off to the sea. In these dry seasons the plants die for want of water.

# Dams Help to Prevent Floods

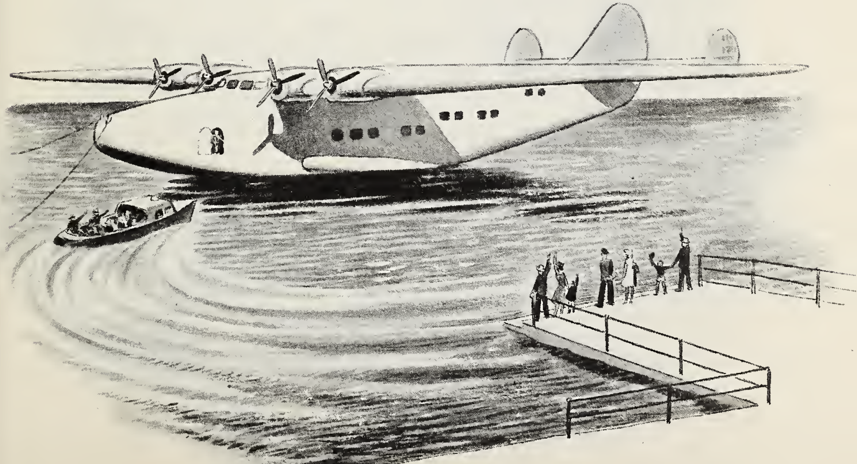
Sometimes dams are built to help hold waters back. They hold the water upstream, so that it may be used in the dry parts of the year. We say the farmers irrigate, or water the land, with the water stored by the dam. As the crops need the water, it is sent from the dam downstream and out into ditches built in the fields.

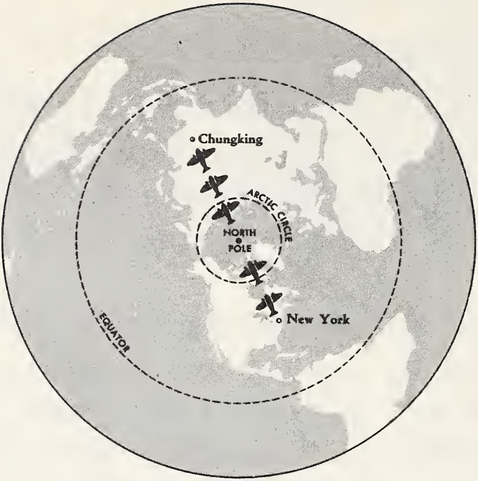
Many large dams have been built on our streams. Dams cost a great deal of money. Yet they are worth what they cost, because they save the water for later use and keep floods from destroying cities and farms.

# Conservation Is Our Job

Today no one in the world should waste anything. We can no longer live as one country and forget about the many millions of people who live in other parts of the world.

Today we are all neighbors. We can step into an airplane and fly to the most distant city in about sixty hours. Once it took from six months to a year to travel from China to New York. Now it takes less than a week. Once it took three months to go from New Orleans to London. Now you can fly from one city to the other in only a few hours.





No longer can we think of feeding only our own people. We must want the children of all the people of the whole world to have good food, warm clothing, and healthful homes.

We have seen what a big problem it is to be sure everyone gets enough good food to keep well and strong. We must all learn better ways to take care of the farm lands which grow our crops. Then there will be food enough for all.

# You Can Help

What can you do about conservation? Well, first of all each one of us can know what conservation means. We can learn about all our natural resources. We can learn to use them more carefully.

Each one of us can start to conserve right in our own homes. We can eat the good food our mothers cook. We can help to raise some of the food in our own home and school gardens.

Many seedlings planted by boys and girls are now beautiful trees. Many wild flowers have been saved because boys and girls have learned not to pick them. Many more birds are now alive because children have set up winter bird-feeding stations and because boys have put away their slingshots.

Campfires enjoyed by boys and girls are put out carefully. No boy or girl wants his carelessness to cause a forest fire. You can learn where it is safe to build a campfire. You must also learn how to smother your campfire before you are ready to leave it.

When someone asks you " How shall we save our natural resources ? " your answer must be " We must all help." Every boy and girl in America, every man and woman in Brazil, every farmer in France, every factory worker in Russia, every fisherman in Norway, as well as every miner in South Africa, must do his part. Everyone who lives anywhere on any of the continents of this earth must help to use more carefully all of the great natural resources which are so valuable to all of us.

You can't do it alone. Your mothers and fathers can't do it alone. Your government can't do it without help. But all of us working together *can* and *must* save the great riches of this earth. Will you help ?

## Can You Find Out

1. How does the river Nile in Egypt help the farmers there by its floods?

2. Write a letter to the United States Forest Service, Washington, D. C. Ask them to tell you the ways in which they are helping to conserve our forests.

3. How is lumbering today different from the lumbering that went on years ago here in North America?

4. Is the cutting of thousands of Christmas trees each year really a good thing? Will our evergreen trees soon be all cut down? About how long does it take for these trees to grow big: pine, oak, poplar, sycamore?

5. How is your very own community helping to conserve forests? Is your father helping? Is your neighbor helping? Have you ever planted a tree and protected it so it could grow?

# Science Words

This part of your book is a science dictionary. It will help you find the meanings of words which are used in your book. The page number following each word shows you on what page the word is first found.

**air.** A mixture of gases which we breathe. We live at the bottom of an ocean of air (p. 55)

**air pres′sure.** The power with which air presses upon things (p. 57)

**a′phid.** A small insect that sucks the juice from plants. Ants get some of this juice from aphids. They use the juice as food (p. 95)

**a quar′i um.** A tank or bowl of water in which fish and plants live (p. 55)

**a scor′bic ac′id.** The vitamin known as C (p. 230)

**at′mos phere.** The gaseous part of the earth (p. 27)

**bee′bread.** Food made by bees for their babies to eat. It is made of pollen and nectar (p. 84)

**cal′ci um.** A mineral needed to build strong bones and teeth (p. 231)

**car′bon di ox′ide.** One of the gases found in air. We breathe out carbon dioxide (p. 66)

**cells.** Small rooms made by bees for storing nectar, beebread, and eggs (p. 79)

**cir′cuit.** The path along which electricity travels (p. 136)

**clouds.** Water vapor that has formed a mist in the air. Fog is a cloud (p. 45)

**com′pass.** A device that tells direction (p. 142)
**com press′.** To crowd into a small space. You compress air when you blow into a balloon (p. 73)
**con duc′tors.** Materials that carry electricity along them easily (p. 139)
**con glom′er ate.** A rock made of sand and small pebbles (p. 262)
**con ser va′tion.** Saving our resources (p. 268)
**con serve′.** To save through wise use (p. 301)

**di e ti′tian.** A person trained to plan meals that are right for us to eat (p. 227)
**dis solve′.** To break up and become part of a liquid. Sugar dissolves in water (p. 260)
**drones.** Father, or male, bees (p. 78)

**earth.** The planet on which we live (p. 5)
**e lec tro mag′net.** A magnet that operates with an electric current. It works when the electricity is turned on. It does not work when the electricity is turned off (p. 141)
**e ro′sion.** The rubbing away of soil and rock by wind and water (p. 284)
**ex pand′.** To spread out or become larger. Metal expands as it is heated (p. 62)
**ex per′i ment.** To try out (p. 13)

**feld′spar.** A common mineral found in many rocks (p. 255)
**fer′ti liz er.** The materials added to soil (p. 200)
**fog.** A cloud near the ground (p. 45)
**fos′sil.** The shape of an animal or plant found in a rock (p. 264)
**fric′tion al elec tric′i ty.** Electricity made by rubbing things together (p. 132)

**gas.** Air is made of gases. We breathe these gases into our bodies (p. 27)
**gas′eous.** Like gas (p. 27)

**gey′ser.** A sudden bursting of hot water into the air from a deep hole in the ground (p. 32)
**gneiss.** A rock made of feldspar, mica, and quartz (p. 258)
**grav′el.** Small stones and earth material made from rock (p. 197)
**grav′i ty.** A power that pulls all things toward the center of the earth (p. 22)

**hi′ber nate.** To sleep part or all of the winter. Frogs hibernate (p. 117)
**horn′blende.** A certain dark-colored mineral found in many common rocks (p. 258)
**hu′mus.** The dark-brown material in soil made of decayed plants (p. 197)

**ice sheet.** A great deal of snow and ice that covered much of our land (p. 10)
**in′sect.** An animal having six legs and three parts to its body (p. 199)

**lar′va.** Rock from a volcano (p. 32)
**lar′vae.** The young of any animal which while young do not always look like their parents. Larvae are often wormlike during this part of their lives. Tadpoles are larvae of the frogs. Caterpillars are larvae of moths (p. 84)
**lime′stone.** Rock made from bones of animals (p. 259)
**lit′mus paper.** A paper treated with a chemical (p. 201)
**loam.** Soil made of fine soil and decayed plants (p. 196)

**mag′net.** A piece of iron or steel which holds to other iron and steel (p. 141)
**male.** The father animal (p. 108)
**mam′mals.** Animals which feed their babies milk (p. 100)
**ma nure′.** A kind of fertilizer (p. 200)
**mi′ca.** A soft shiny mineral found in many rocks (p. 252)

**mica schist.** A common rock containing mica (p. 259)
**mi′cro scope.** A device that makes small things look larger (p. 248)
**mi′grate.** To move or travel from place to place. Some birds migrate (p. 114)
**min′er al.** Rock found in the earth. Coal is a mineral (p. 200)
**mix′ture.** Two or more things mixed together (p. 64)

**nat′u ral re sourc′es.** The natural wealth of a country. Minerals, soil, and water are natural resources (p. 274)
**nec′tar.** The sweet sap found in flowers (p. 77)
**ni′tro gen.** One of the gases found in air (p. 65)

**or gan′ic mat′ter.** Plant materials that are decayed (p. 200)
**ox′y gen.** One of the gases found in air. We use oxygen in our bodies (p. 64)

**phos′pho rous.** A mineral needed by the body (p. 132)
**plan′et.** A body which turns around the sun. Our earth is a planet (p. 5)
**pol′len.** The dust found inside flowers (p. 84)
**pol′len bas′kets.** Baskets found on the hind legs of worker bees (p. 86)
**pro′tein.** A kind of food material used by the body (p. 232)
**pu′pae.** A period of growth of an insect, when it rests in a case (p. 84)

**quartz.** A shiny mineral found in many rocks (p. 249)
**queen bee.** The mother bee (p. 78)

**re for est a′tion.** Replanting of trees where they once were (p. 289)
**re volve′.** To turn around another thing. The earth revolves around the sun (p. 19)

**ri bo fla′vin.** The vitamin known as $B_2$ (p. 230)
**ro′tate.** To turn around on itself. A spinning top rotates (p. 12)

**sand′stone.** A kind of rock made from sand (p. 261)
**sci′en tist.** A person who has studied science carefully and has experimented with and discovered things about science (p. 12)
**short cir′cuit.** An accidental touching of the wires carrying electricity (p. 137)
**so′cial an′i mals.** Animals that live together are social animals (p. 77)
**soil.** The top layer of ground (p. 196)
**sol′i tary animals.** Animals that live alone are solitary animals (p. 118)
**stra′to sphere.** The upper part of the atmosphere. The stratosphere begins about seven miles above the surface of the earth (p. 40)

**ther mom′e ter.** A device that measures heat (p. 39)
**top′soil.** The layer of soil at the surface of the earth. Our plants grow in it (p. 282)
**trop′o sphere.** The lower part of the atmosphere (p. 39)

**u′ni verse.** The solar system and all the stars throughout space make up the universe (p. 7)

**vi′ta min.** A substance in food that helps our bodies keep well (p. 202)
**vol ca′no.** A mountain which can shoot out melted rocks and gases (p. 32)

**wa′ter va′por.** Water in the gaseous state. Clouds contain water vapor (p. 46)
**work′er bees.** The workers in the beehive. They do all the work except laying eggs (p. 78)

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